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Effectiveness of the mobile technology intervention in rural schools: The case of Seshego circuit in Polokwane district

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Effectiveness of the mobile technology intervention in rural schools: The case of Seshego circuit in Polokwane district

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WITS Graduate School of Governance

Thesis presented in partial fulfilment for the degree of Master of Management (in the field of Public Sector Monitoring and Evaluation) to the Faculty of Commerce, Law, and Management, University of the Witwatersrand

November 2021

DECLARATION

I Nare Mahwai declare that this research report entitled 'Effectiveness of the mobile technology intervention in rural schools: The case of Seshego circuit in Polokwane district' is my own unaided work. I have acknowledged, attributed, and referenced all ideas sourced elsewhere. I am hereby submitting it in partial fulfilment of the requirements of the degree of Master of Management (Public and development sector monitoring and evaluation) in the University of the Witwatersrand, Johannesburg. I have not submitted this report before for any other degree or examination to any other institution.

Nare Joyce Mahwai

Signed at Johannesburg on 23

November 2021

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ABSTRACT

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Thesis title: Effectiveness of the mobile technology intervention in rural schools: The case of Seshego circuit in Polokwane district

The objective of this qualitative study is to conduct a summative evaluation of a mobile technology intervention in rural schools of Seshego circuit. The aim is to determine the effectiveness of the intervention to determine how mobile technologies are integrated in teaching and learning. Employing a qualitative research strategy with case study research design methods, participants were purposively selected to answer four research questions to determine the outcomes of the information and communication technology intervention in rural schools of Seshego circuit in Polokwane district. Teachers' views were obtained regarding the integration of mobile technologies in teaching and learning as well as documenting the process for mobile technology integration in teaching and learning.

This research applied technology acceptance model (TAM) and Technology acceptance model 2 (TAM2) to make understand the use and integration of mobile technologies in teaching and learning. Preliminary findings reveal that mobile technology integration does end with providing schools with information and communications technology infrastructure, there has to be a deliberate effort from teachers, learners, school management, subject advisors, national and provincial department of education to ensure that mobile technologies are used and integrated in teaching and learning. There are barriers that prevents teachers from fully integrating technologies in teaching and learning like the availability of ICT infrastructure as well as lack of skills and knowledge to integrate mobile technologies in teaching and learning. This research recommends that teachers be placed at the heart of technology implementation in teaching and learning.

Johannesburg, November 2021

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DEDICATION

To my late grandmother, Raisibe Mancha Salome Mabotja, your love for education inspired me throughout my academic journey, I know you would have loved witnessing this…Robala ka kgotso Mancha'a borakgwadi.

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1 INTRODUCTION TO THE RESEARCH

1.1 Background

The focus of this research is to conduct a summative evaluation of a mobile technology intervention in rural schools of the Seshego circuit. Before outlining the research problem statement (Section 1.2.1), and consequently the purpose (Section 1.2.2) and the research questions (Section 1.2.3), the researcher briefly introduce the terms and concepts that were used in conceptualising this research. Section 1.1.1 introduces the research context generally and broadly, while Section 2.1 contains a related but more detailed discussion thereof. Section 1.1.2 briefly introduces the programme under study, as well as the accompanying key terms and concepts. Section 2.2 provides for a more detailed discussion on this intervention.

1.1.1 The Seshego Circuit's rural schools in brief

Information and Communications Technologies (ICTs) have the power to address or eliminate most barriers in education, health, economics and many other sectors in developing countries (The Department of Education White paper on e-Education, 2006). The Department of Basic Education in South Africa has started to provide schools with technologies for both teachers and learners, to create new ways of teaching and learning (The Department of Education White paper on e-Education, 2006). Many teachers and learners are adopting the benefits of ICTs to improve the quality of education and improve teaching and learning generally. For schools (teachers, learners, principals and school governing body) to realise these benefits, the Department of Education needs a planned process for the integration of ICTs into schools (Beyers and Hlala, 2015).

Different types of ICT infrastructure have been rolled out in many schools in South Africa. However, the rollout of ICT happens in a fragmented manner by various government departments, NGOs, provincial and national departments of Education (Meyer and Gent, 2016). Various authors (Meyer and Gent, 2016 and Ainooson-Noonoo, 2016) agree that the Department of Education should lead the ICT rollouts in schools, but that there is no strategic plan on how this has to be done and how the ICT would be integrated into schools. The South African Department of Education has an ICT strategy; however, the implementation of this strategy is not fully explained to teachers, circuit managers, subject advisors, as well as all the relevant stakeholders who are the foot soldiers for implementation at school level (Meyer and Gent, 2016 and Mdlongwa, 2012).

The strategy should also change the key performance indicators of teachers to cater for new ways of teaching with mobile technologies.

According to a study done by Ghoord (2013), desktop computers represented the technologies that were in use in the Capricorn district; they are primarily used for administrative purposes, and the researcher could therefore claim that some of the rural schools in this district, including those in Seshego circuit, would either be far behind the schools that Ghoord studied in 2013, or be on par with the schools that were under study and adopted technologies for administrative purposes only. Things could have changed in the Capricorn district as this study was carried out seven years ago; however, a study by Meyer and Gent (2016) reported that Limpopo and Eastern Cape, as two of the most rural provinces, have the lowest footprint of technologies in schools; hence, the picture from Ghoord might not have changed significantly.

1.1.2 Mobile technologies in Seshego circuit rural schools

The unavailability of suitable infrastructure for Information and Communications Technologies (ICT) is increasing the digital divide between the developing and developed world. ICTs provide courage for the elimination of the barriers of segregation socially and geographically, improve access to information and education, and empower the under-resourced rural schools to take part in making decisions that influence their lives (e-Education White paper, 2003). Africa needs to educate and produce ICT-competent learners who are ready for the world of work in all sectors, including engineering, programming and technology development (e-Education White paper, 2003).

The 21st century started with technological innovations that had implications for the improvement of the fields of education, health and rural development (Mdlongwa, 2012). The application and integration of ICT in teaching and learning has great benefits in assisting government to produce youth that have 21st century skills such as collaboration, digital literacy, critical thinking and problem solving (Fu, 2013 and Tondeur, Krug, Bill, Smulders and Zhu, 2015). Many teachers have never been exposed to technologies in teaching and learning and were introduced to technologies for everyday use in their adult lives. Thus, they find it more difficult to use Information and Communications Technologies (ICTs) for teaching and learning than their learners do. ICTs include computers, smart phones, tablets, the internet and electronic delivery systems such as projectors. ICTs positively impact education and training for both teachers and learners (Fu, 2013).

The Council for Scientific and Industrial Research (CSIR) in Pretoria, South Africa, was mandated by the Department of Agriculture and Rural Development (DARD) to implement the ICT for Education Project (ICT4E) over a period of three years (2017-2019). The main objective of this mobile technology project was to improve the quality of teaching and learning in a rural context by introducing technologies, frameworks and approaches that positively influence the teaching and learning process (Herselman, Botha and Maremi, 2019). Technologies were deployed to 24 beneficiary schools, and comprised 48 mobile tablets, MI-FI Hotpot and broadcast internet, relevant teaching software and content for both teachers and learners, server with free teacher and learning resources and 10 additional teacher tablets (Herselman, Botha and Maremi, 2019).

The scope of the project included: (Herselman, Botha, and Maremi, 2019)

- Pre-implementation ICT Audit of the 24 schools;
- Procurement and deployment of the schools' ICT Infrastructure;
- Design, development and delivery of training to facilitators and teachers; and
- Monitoring and Evaluation.

As part of the project, teachers were trained on how to use the ICT infrastructure, including mobile technologies, for teaching and learning (Herselman, Botha, Marais, Dlamini and Mahwai, 2019). The University of the Free State accredited the teacher training programmes (teacher professional development, TPD) (Dlamini and van der Vyver, 2019). The project also included training for School ICT technicians (two for each school to support teachers with technical issues) (Herselman, Botha and Maremi, 2019). The DARD selected 24 schools in 7 provinces of South Africa (Gauteng, Eastern Cape, Free State, Northwest, Northern Cape, Kwa-Zulu Natal and Limpopo), and the principals of the selected schools had to identify 10 suitable teachers who received teacher professional development through accredited training materials (Herselman, Botha and Maremi, 2019).

1.1.3 Summative evaluation in brief

In order to understand ICT in Education in its entirety, the researcher also describe e-learning and mobile learning; this is necessary because the study's focus is on the evaluation of mobile technologies and their impact on the process of teaching and learning. Beyers and Hlala (2015, p 165) describe E-learning "as a set of practices which enhance people's potential to learn with others via technology-aided interaction" while "M-learning can be described as learning that occurs when a learner is not at a fixed,

predetermined location that makes use of mobile technologies to access, explore and assess information" (City of Polokwane, 2014, p.21; Feser 2010, p.112).

This study conducted a summative evaluation of a mobile technology intervention to determine the effectiveness of integration of mobile technologies in teaching and learning. "Summative evaluation is a study conducted at the end of an intervention (or a phase of that intervention) to determine the extent to which anticipated outcomes were produced. Summative evaluation is intended to provide information about the worth of the program" (Kusek and Rist, 2004, p. 229).

1.2 Towards the effectiveness of the mobile technology interventions in rural schools: The case of the Seshego circuit in the Polokwane district

1.2.1 The research problem statement

ICTs have been rolled out in many schools in South Africa. The rollout of ICT happens in a fragmented manner by various government departments, NGOs, provincial and national departments of Education (Meyer and Gent, 2016). Various authors (Meyer and Gent, 2016; Tondeur, Krug, Bill, Smulders and Zhu, 2015; Voogt and Tondeur, 2015; Tondeur, van Braak, Ertmer, Ottenbreit-Leftwich, 2015 and Ainooson-Noonoo, 2016) agree that the Department of Education should lead the ICT rollouts in schools; however, there is no strategic plan on how this has to be done and how the ICTs would be integrated into schools.

The Department of Education, as well as private funders, continue to make big investments in ICTs in Education with the hope that this will solve all other societal challenges (Ngobeni, 2017). However, due to the inequalities that exist in different areas, ICT often competes with other fundamental needs such as proper classrooms, sanitation, water, furniture and electricity (Polokwane local municipality, 2016 and Ngobeni, 2017). The Departments of Education in rural areas are unable to make sufficient progress with the rollout of modern technologies in schools because their priorities are different from those of schools in urban areas. Although there are norms and standards for infrastructure provision in education, each district provides infrastructure according to the unique needs of that area (Polokwane local municipality, 2016 and Ngobeni, 2017). It is not surprising that Limpopo and the Eastern Cape provinces have the lowest penetration of ICT in

schools (Meyer and Gent, 2016). The challenges that these Departments of Education experience differ from those of other provinces.

In the Seshego circuit, the current main priority is the provision of proper building structures, water and sanitation, as well as creating a conducive environment for teaching and learning (Polokwane local municipality, 2016). Because of this, the Seshego circuit is, like all other rural areas, lagging behind when it comes to ICT infrastructure provision in schools (Polokwane local municipality, 2016). Due to the lack of ICT infrastructure in the Seshego rural areas, the then Department of Rural Development and Land Reform (now known as the Department of Agriculture, Rural Development and Land Reform) collaborated with various stakeholders to initiate the process of integrating mobile technologies in teaching and learning in those rural schools to improve the quality of education. In 2016, the department seconded the Council for Scientific and Industrial Research (CSIR) to undertake a project called Information and Communications Technology for Education (ICT4E) in 24 schools in seven provinces of South Africa, including Limpopo, with a specific focus in rural Seshego circuit schools. The project aimed to improve the quality of education through modern technologies for teaching and learning, as well as provide teacher professional development through accredited training materials. Teachers were trained because an investment in teacher training is considered much more important than investing in technologies (Vosloo, 2010). Teacher support through continuous training improves teaching practise and gives teachers an opportunity to incorporate new ways of delivering pedagogy.

Proper monitoring and evaluation plans must be in place to measure the outcomes of the technologies on teaching and learning, to verify that teachers and learners indeed acquire the required skills through the department's intervention. The South African government is also currently moving towards conducting monitoring and evaluation of all interventions that they carry out to improve the lives of the citizens. For this reason, this research carries out a summative evaluation of the ICT intervention implemented in rural schools of the Seshego circuit; the purpose is to ascertain that the ICT4E initiative by the Department of Agriculture, Rural Development and Land Reform, along with various stakeholders, has achieved its intended objective of successfully integrating mobile technologies in teaching and learning, with a specific focus on teachers in rural schools of Seshego circuit.

1.2.2 The research purpose statement

The purpose of this research is to determine through a summative evaluation what outcomes (at the level of the teachers) mobile technology use and integration has had in teaching and learning in the rural schools of the Seshego circuit in Limpopo's Capricorn District. For this purpose, the research seeks to establish (i) the intended outcomes of the intervention for the teachers; (ii) the importance of using and integrating mobile technologies in teaching and learning; (iii) factors that either motivate or prevent teachers from integrating mobile technologies in teaching and learning; and (iv) how mobile technologies can be effectively applied and integrated in teaching and learning.

This study is positioned under the academic field of study of Information and Communications Technology, which comprises the separate components of information, communication and technology. The components had to be broken down to variable and/or attribute level; technology hardware and technology software were identified. These attributes were used in answering the research questions and identifying the interpretive frameworks for the study. This research employs an interpretive inquiry to cross-examine how mobile technologies are used and integrated in teaching and learning.

The research utilised a qualitative research strategy and a case study research design to collect data to determine the extent to which mobile technologies are integrated in teaching and learning, following the implementation of the ICT intervention in schools. Data was collected using document analysis, telephonic interviews and school surveys. A Microsoft Excel spreadsheet was used to capture and analyse the data. The study followed thematic content analysis to further make sense of the data through themes that emerged from the responses to the research questions. The Technology Acceptance Model (TAM) by Davis (1986) and the Technology Acceptance Model 2 (TAM2) by Davis and Venkatesh (2000) were identified as appropriate frameworks within which to discuss the research findings.

The study concludes with recommendations on how mobile technologies can be used and integrated in teaching and learning and identifies barriers that should be eliminated to successfully implement ICT interventions in schools.

1.2.3 The research questions

The following research questions were examined:

1. What were the intended outcomes of the ICT4D initiative for the teachers?
2. Why is it important to use and integrate mobile technologies in teaching and learning?
3. What influences teachers to use and integrate technologies in the process of teaching and learning?
4. How can mobile technologies be used and integrated in teaching and learning?

1.3 Delimitations of the research

Although the project was implemented across seven provinces of South Africa, the research focuses on mobile technology integration into three rural schools of the Seshego circuit, in the villages of Moletjie. The broad field of study is Information and Communications Technology, the interrogation of which led to the realisation that ICT's can be understood through technology hardware and software. This study focuses on how technology hardware and software are integrated in the process of teaching and learning. The ICT device that is under study is the mobile tablet.

The study will not focus on whether the learners' marks have improved since the inception of the project or not. The researcher wants to understand how mobile technologies are integrated in the process of teaching and learning, and what changes (if any) took place in the process of teaching and learning since the project's implementation in 2017. The focus is on changes in teachers' behaviour since the project's implementation — that is, how are they using and integrating the technologies into teaching and learning.

1.4 Justification of the research

An evaluation of any project is important because it will inform stakeholders (government, managers of education, headmasters, teachers, and students) how mobile technology is being integrated into the teaching and learning processes. Government will know the cost–benefit and the ease of use upon the integration of mobile technology into schools. It will enable school management to know whether teachers would benefit and be able to adequately use mobile devices in the classroom to teach effectively, and it would identify the types of mobile devices that they would love and find easy to use. Students would gain from the project by knowing the benefits of mobile technology for education and learning the various software available in the market and how to integrate it into their learning process.

It would provide South African Department of Education with the necessary opportunity to facilitate the provision of adequate infrastructure, such as ICT resource centres and computers, in schools. It would also assess whether the various action plans for the ICT education policy, namely that all South African students should have ICT access, is being accomplished. This would also serve as an input for the South African Department of Education and the Government in integrating mobile technology in the implementation of the ICT policies for the nation. Finally, the study expects to contribute to the body of knowledge on mobile technology use in schools.

1.5 Preface to the research report

The report has six chapters. The introductory chapter presents the background, context and research conceptualisation (general and thesis statement, purpose statement and research questions) of the study, as well as the delimitation and justification of the research report. The literature review in Chapter 2 addresses the history of mobile technology integration into South African schools broadly, as well as mobile technology integration into the Seshego circuit specifically. Past studies aimed at evaluating mobile technology integration into the process of teaching and learning have identified barriers to the applications of ICT, such as availability of resources and lack of teacher professional development. ICT, as a broad field of study, is unpacked to identify the explanatory interpretive frameworks and the conceptual framework of the study. Chapter 3 discusses the research strategy, design, procedures, reliability and validity measures, as well as limitations that applied when the summative evaluation was carried out.

Chapters 4 and 5 present and discuss the findings that emerged through interrogation of the research questions. The latter are answered through data collected, and the implications of the results are discussed to determine if mobile technologies were successfully applied and integrated into the selected schools. Teachers report to have been trained on how to use the mobile technologies in the classrooms; some teachers were able to use the technologies in class, while others were unable to do so due to theft and vandalism. The results show that teachers are willing and able to use technologies in teaching and learning; however, more tablets are needed. The tablets provided by the intervention were shared by learners, due to a limited number of devices. Teachers reported that they want to continue using the mobile technologies in teaching and learning, due to the many benefits, such as having access to more content on the internet, improving their ICT skills and knowledge, and improving the overall behaviour of learners in schools.

Chapter 6 summarises and concludes the research. It captures research limitations as well as recommendations for policy implications. ICT interventions in schools should put the teacher at the heart of the application and integration process, because they have the biggest influence on the learning and teaching process. School management should provide teachers with support to continue using and integrating mobile technologies in teaching and learning.

2 LITERATURE REVIEW

2.1 Seshego Circuit rural schools: history and description

This chapter has four objectives, namely, to understand the research problem (Sections 2.1 and 2.2), to identify the knowledge gap (Section 2.3), to develop a theoretical framework for interpreting the findings (Sections 2.4, 2.5, and 2.6), and to conceptualise the research approach (Section 2.7). Specifically, Section 2.1 briefly describes the research context in preparation for Section 2.2, in which the researcher details the research problem. In Section 2.3, literature is reviewed on studies that have attempted to evaluate the integration of mobile technologies into rural schools. With this knowledge, Sections 2.4 and 2.5 situate the research within ICT studies and their key components and attributes. Section 2.6 presents a summary of theories relevant to ICT studies. The final Section (2.7) provides a conceptual framework to guide the research process of mobile technology integration into rural schools.

This is the first sub-section of an outcomes-based literature review, wherein the research problem is understood by unpacking the research context analysis as well as the problem analysis (Wotela, 2016). Our context is the Seshego circuit rural schools, and our problem is mobile technology integration into rural schools. The history sections give an overview of the Seshego circuit and the history of mobile technology integration into the circuit as a means of understanding the context. The problem analysis is unpacked by describing the causes, symptoms and consequences of not integrating mobile technologies in rural schools.

The history of these schools assists in mapping the process of mobile technology integration and use in teaching and learning. The researcher will also understand the outcome of mobile technology integration through context analysis because the schools have already started using technologies in their teaching and learning. Section 2.1.1 details the context, and Section 2.1.2 outlines the history of mobile technology integration into the circuit. The researcher will interrogate the research problem in more detail in Section 2.2.

2.1.1 Seshego circuit

Polokwane local municipality is a category B municipality that forms part of the Capricorn district municipality in Limpopo province. The municipality is at the centre of the Limpopo province and covers an extensive area of 377 579 hectares with a population of approximately 700 000 people; its 178 001 households have an average of four (4) family members (Abrahams, 2017 and Statistics South Africa, 2011). Polokwane local municipality's population comprises a majority of black Africans at 92, 9%, while white people form 5% and the remaining 1.9% comprises other population groups (Statistics South Africa, 2011). The municipality shares a name with the capital city of the province, Polokwane town (Statistics South Africa, 2011). Polokwane (previously Pietersburg, until 2002) is a Northern Sotho name meaning "a place of safety" (Capricorn District municipality, n.d.).

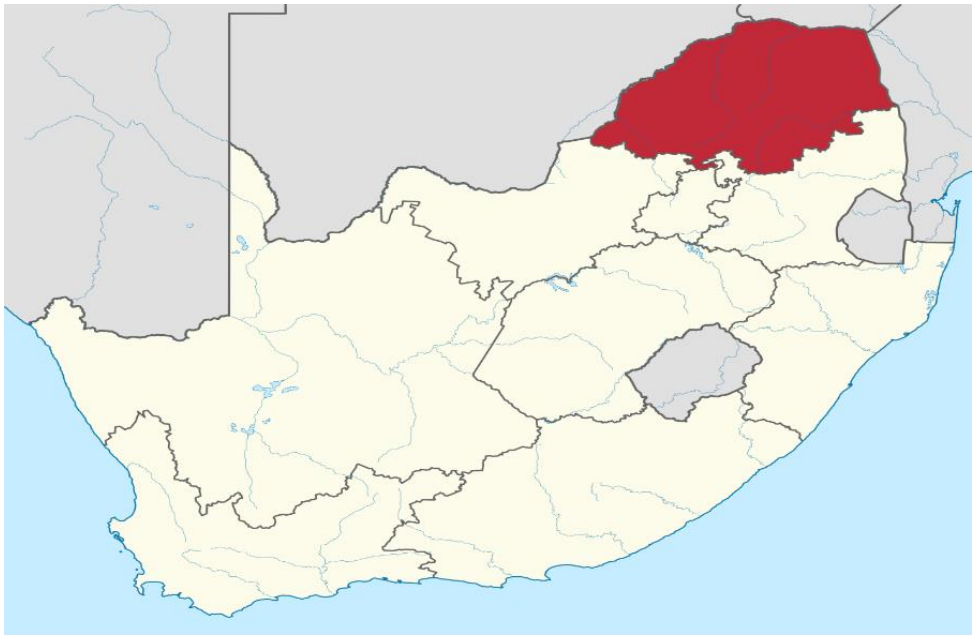

Figure 2.1. The Map of South Africa, with the Limpopo province in red. (Source: Capricorn District municipality (n.d.))

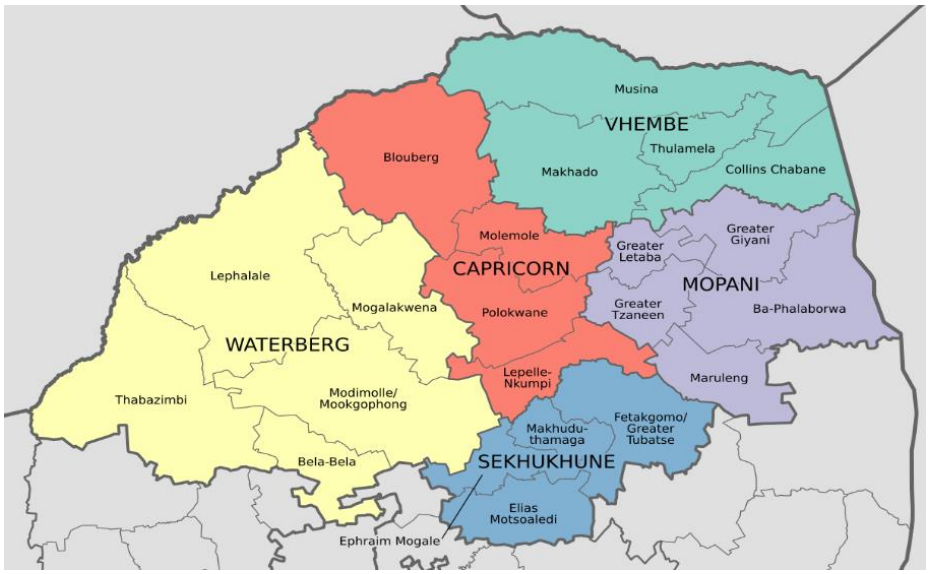

Figure 2.2. The map of Limpopo, showing its five district municipalities (Source: Capricorn district Municipality)

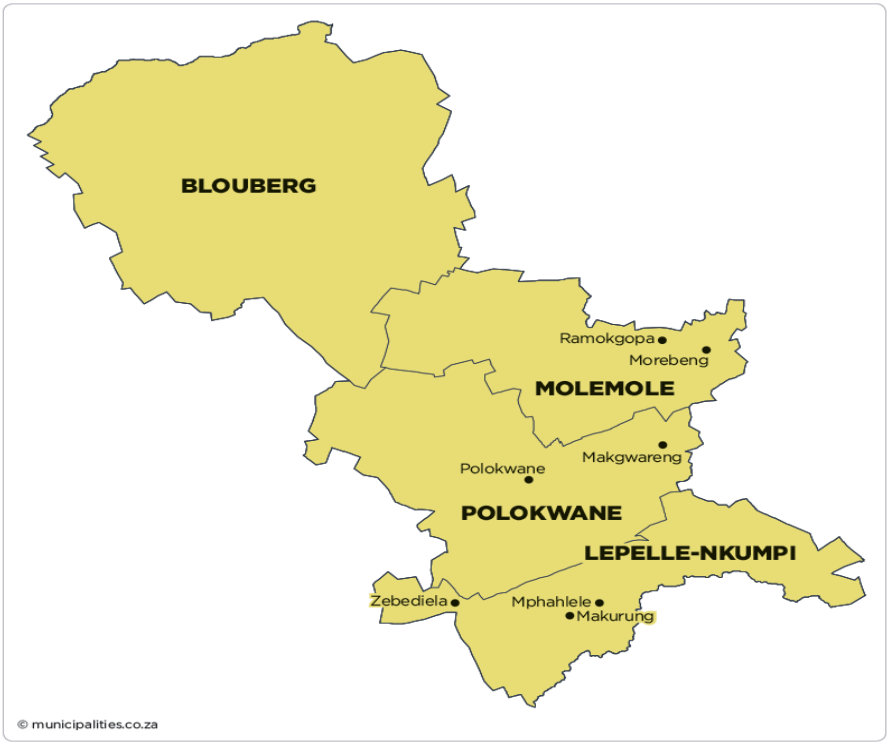

Figure 2.3. Capricorn district municipality map showing the four local municipalities. (Source: Municipalities.co.za)

Polokwane local municipality has a youthful population, with most people counted by the 2011 census as being 24 years old and younger (Statistics South Africa, 2011 and Limpopo provincial government, 2019). The population older than 25 years is declining, because it includes the youth that go to other provinces (usually Gauteng) for better employment

opportunities (Limpopo provincial government, 2019 and Polokwane local municipality, n.d.). Capricorn district municipality does not have a good retention strategy for the youth that graduate from the local colleges in the province, resulting in migration to other provinces.

Seshego, a township 10km outside Polokwane town, was established in the 1960s during the apartheid dispensation for Northern Sotho speakers to provide cheap labour to the nearest town (Abrahams, 2017). Seshego was the temporary capital of the former Bantustan of Lebowa from 1972 to 1974 (Abrahams, 2017).

The three schools, namely Matsiri Mokgokong Primary school, Mochocho Primary school and Mohlapetse Secondary school (the focus of this study) are in the Seshego circuit of the Polokwane district. The structure of the Department of Education has the national department at the top, followed by the provincial department, which is comprised of districts and circuits (Ndlovu, 2017). The schools report directly to the circuit managers (Ndlovu, 2017). The rural schools are 10km from Seshego Township in the village of Moletjie and are situated within 5km of each other. The schools are all public non-fee-paying schools. The schools were part of Aganang local municipality until 2016, when it merged with the Polokwane local municipality to become part of the Capricorn district municipality (Capricorn District Municipality, n.d.).

The three schools in this study are part of an ICT4E initiative funded by the Department of Agriculture, Rural Development and Land Reform. Mobile technologies (tablets) for both teachers and learners, as well as internet connectivity, were deployed to the schools for teaching and learning.

The Polokwane local municipality strives to adhere to the norms and standards of infrastructure provision in the education sector—especially schools (Polokwane local municipality, 2016). The focus is on building schools with proper structures, providing water and sanitation for the learners, and creating a school environment that is conducive to learning (Polokwane local municipality, 2016). A main priority of the province is the provision of toilets, due to an earlier tragedy wherein a learner drowned in a pit toilet (Polokwane local municipality, 2016). The province has prioritised the provision of other infrastructure besides ICTs (mobile technologies/tablets); however, this does not mean they have not collaborated with other stakeholders to start introducing technologies in schools.

2.1.2 The history of mobile technology integration into South African Schools.

In the 1980s, computers were introduced in South African private schools and some well-resourced government schools (Mdlongwa, 2012). Initially, these computers were used for administrative work such as printing reports, typing question papers, creating timetables and recording examination marks (Mdlongwa, 2012). As ICTs advanced, more infrastructure was introduced to be used for teaching and learning, in addition to administrative work (Mathevula and Uwizeyimana, 2014 and Mdlongwa, 2012). The rapid expansion of ICTs in schools brought about opportunities for learners, teachers, schools administrators, subject advisors, district officials, provincial and national officials as well as the DHET, HEI and all ICT service providers (Maboya, 2018 and Amedzo, 2007). The expansion brought about what scholars refer to as the knowledge society, which allows everyone who is ICT competent to compete with others as a global citizen (Maboya, 2018 and Amedzo, 2007). This rapid expansion prompted the Department of Basic Education to develop processes and policies to guide the integration of ICTs from the national to the school level to improve the quality of education in South Africa (Maboya, 2018 and Amedzo, 2007). The ICTs that are being introduced are a combination of networks, hardware and software, as well as the means of communication, collaboration and engagement that enable the processing, management and exchange of data, information and knowledge (Ojo and Adu, 2018 and Amedzo, 2007). The mobile phone is one of the most used and successful technologies, and it is estimated to be used by 95% of students (Beyers and Hlala, 2015).

In response to the expansion of ICTs, the Department of Basic Education drafted the White Paper on e-Education in 2004 (Amedzo, 2007), with the following goal (see Section 2.23): "Every South African manager, administrator, teacher and learner in general and further education and training will be ICT capable by 2013." (Department of Education, White Paper on e-Education, 2004, p. 17). As it stands in 2019, there has been some progress made in the right direction; however, a lot still needs to be done to achieve the main goal of the policy. In 2015, Jeff Radebe (Minister in the presidency for Planning, Monitoring and Evaluation) and the minister of Basic Education Angie Motshekga launched a program called Operation Phakisa to transform education through the adoption of ICTs, and to monitor and evaluate the implementation of ICT in schools (Kwet, 2017).

The South African e-Education policy was introduced to transform learning and teaching, to move South Africa towards a knowledge society and to bridge the digital divide between the developing and developed world (Vandeyar, 2015; Chisago and Lesame, 2017 and Mdlongwa, 2012 and Unwin, 2015). The e-Education policy reasons that the use of ICT will improve teaching and learning: teachers would change how they teach, while learners would acquire new skills associated with technology use in class (Mdlongwa, 2012 and Vandeyar, 2015).

The Department of Education White Paper on e-Education did not have a clear plan as to how to implement the technologies in education; the department assumed that the policy would change teachers' practice, while bringing about new pedagogical practices naturally without being formally facilitated (Vandeyar, 2015). Any innovation demands an emergence and development of a new set of skills, attitudes and pedagogical approaches (Vandeyar, 2015 and Mathevula and Uwizeyimana, 2014). There is also a need for continuous training and capacity development amongst teachers, administrators, principals, developers and trainers (Vandeyar, 2015 and Mathevula and Uwizeyimana, 2014).

Some schools are equipped with new technologies to bridge the gap between private and public schools; however, neither the learners nor the teachers are equipped to use these technologies in teaching and learning (Habibu, Al-Mamun and Clement, 2012; Chisago and Lesame, 2017; Vandeyar, 2015 and Mathevula and Uwizeyimana, 2014). There is a need to accelerate the process of capacitating schools to fully utilise the ICTs provided to them (Vandeyar, 2015 and Mathevula and Uwizeyimana, 2014).

2.2 Challenges in integrating mobile technologies in rural schools: symptoms, root causes and consequences

The previous sub-section looked at the physical context of the research and the history of mobile technology integration into rural schools. It assisted us to understand the challenges of mobile technology integration better by providing a glimpse of how the circuit has implemented mobile technologies in teaching and learning. In this section, the research delves deeper into understanding the challenges by interrogating the symptoms, causes and consequences of mobile technology integration into rural schools. Section 2.2.1 interrogates the symptoms of not integrating technologies in teaching and learning, followed by Section 2.2.2 that details the causes of the problem and Section 2.2.3 that interrogates the consequences of not integrating mobile technologies in rural schools.

This sub-section is ended by detailing the results chain related to mobile technology integration into rural schools.

The White Paper on e-education (South African Department of Education, 2006, p8) outlines one of the challenges posed by the ICT revolution as technology integration into the teaching and learning process. ICT integration goes beyond the use of technology in classrooms; it involves the use of technology to acquire skills such as critical thinking, collaboration, evaluation of content, problem-solving, access information online and presentation to and communication with others beyond the classroom (South African Department of Education, 2006)

It is crucial to understand the challenge that ICTs pose to teaching and learning. An understanding of the challenges, symptoms and root causes assist decision-makers to plan the process of ICT integration into schools better, and to optimise the use of ICTs to improve the quality of education. This would assist learners in acquiring 21st-century skills, while also assisting teachers in harnessing new ways of delivering content to their learners in this digital age.

To achieve the objective of this section, the researcher reviewed literature on challenges that prevent the full utilisation of ICT for teaching and learning in schools.

2.2.1 Symptoms of non-integration of ICT rural schools:

Nddide, Babikwa, Lubega and Baguma (2019) assert that there is a high student computer/tablet ratio. Usually, more than two learners must use one computer/tablet. Classrooms sometimes have more than 40 learners, while they have a limited number of technologies in the labs; this is especially the case in public schools in rural areas. Teachers usually do not have dedicated time to utilise technologies for teaching and learning. They perceive it as a waste of time because the ICTs are not part of the curriculum or the teachers' key performance indicators.

Mabila (2017) and Mdlongwa (2012) agree that teacher training institutions are still producing teachers that are equipped with old ways of teaching; this is problematic because teachers leave institutions of higher learning unprepared to function with ICTs for teaching and learning, or for using it for administrative purposes. Teachers still rely on the old methods of chalk and duster for teaching. Some teachers also have a negative attitude towards ICTs because the school management does not give them sufficient support and resources to integrate technology in teaching and learning (Maboya, 2018, Mabila, 2017 and Chisago and Lesame, 2017). Any form of teacher professional

development in schools should be evaluated to determine its impact on teaching and learning.

There is no available in-service training on ICT integration for teaching and learning (Ojo and Adu, 2018). The Department of Basic Education and school management do not encourage teachers to enrol in courses that teach ICTs and how to integrate them into teaching and learning (Mabila, 2017 and Mdlongwa, 2012). Schools do not adhere to the ICT policy drafted by the department, because they are not sure how to implement the objectives (Meyer and Gent, 2016). The current issues with electricity in South Africa also hamper the use of ICTs in teaching and learning. The current loadshedding problems that South Africa faces means there is limited time where learners can use mobile technologies as they must be charged, and the batteries usually do not last the whole day therefore some classrooms will have to revert to chalk and duster methods.

2.2.2 Causes of non-integration of ICT in rural schools

Many factors affect technology integration into teaching and learning.These factors include the accessibility and availability of the technologies, the availability of skilled teachers, support from school management and the cost of maintaining the technologies. Mabila (2017) and Habibu, Al-Mamun and Clement (2012) indicate that teachers are sometimes resistant to use ICTs for teaching and learning because:

- Training on how to use the ICTs for teaching and learning;
- They are not comfortable and confident with using ICTs;
- They perceive ICTs as a deviation from their normal teaching process and therefore do not make time to integrate the ICTs in teaching and learning;
- No policy guides how teachers should integrate ICTs in teaching and learning ; and
- Teachers are still measured on old KPIs that do not include the use of technologies as part of teaching and learning.

Accessibility and availability of ICT infrastructure remain a problem for many rural schools in developing countries, including South Africa. "When used as an information technology term, infrastructure refers to the underlying technical components and processes (generally hardware, software and delivery mechanisms) that are used to deliver

information technology services" (Beyers and Hlala, 2015, p.166). The Department of Basic Education in South Africa, as in any other developing world country, is deploying an increasing number of ICTs in schools to improve its accessibility and availability for teachers and learners (Chisago and Lesame, 2017; Mathevula and Uwizeyimana, 2014 and Beyers and Hlala, 2015).

However, Maboya (2018), Mabila (2017) and Chisago and Lesame (2017) indicate that there is no consistent sector-wide implementation process for the deployment of ICTs in South African schools. South African district and provincial e-learning officials are inadequately equipped to deal with the implementation of the national e-Education policy, and this affects their ability to offer support to schools. The department expects that, after providing ICTs to the schools, the process of ICT implementation will naturally change teachers' attitudes, increase confidence and be fully utilised in teaching and learning. Providing the copy of the ICT policy in schools is not enough to propel teachers to integrate technologies into teaching and learning. Teachers need training, while schools need competent technical support for e-learning implementation. From a research and academic perspective, the e-Education White paper on Mobile learning is a comprehensive and modern policy; however, its major failure is its lack of implementation process for mobile learning in schools. In places where some implementation of the e-Education policy takes place, there is no documented proof of how the implementation is done and what changes (if any) have been observed (Meyer and Gent,2016)

The Department of Basic Education collaborates with stakeholders such as other government departments and non-governmental organisations such as SchoolNet to provide ICTs in schools through various programmes such as the laptop initiative, ICT4RED project, The ICT4Education project (24 schools project), teacher professional development and iSchools initiative to support the integration of ICTs into education (Pholotho and Mtsweni, 2016). Some of these programs happen in a fragmented manner and are not monitored and evaluated to assess their impact on teaching and learning to inform how future programs and policies should be implemented, based on the lessons learned from these programs (Pholotho and Mtsweni, 2016 and Mathevula and Uwizeyimana, 2014). For this reason, this study conducts a summative evaluation of the intervention to determine its intended outcomes, with specific focus on teachers as a main catalyst in teaching and learning.

Teachers need assurance and support from school management to integrate technologies into teaching and learning. The lack of skills and knowledge on how to use ICTs in

teaching and learning is one of the reasons why some teachers are reluctant to use ICTs in their classrooms; teachers need training programmes on how to integrate ICTs into teaching and learning (Mabila, 2017; Chisago and Lesame, 2017 and Mathevula and Uwizeyimana, 2014). Some teachers fear that ICTs in classrooms will make them lose control of the process of teaching; therefore, they reject the technology used in classrooms (Mathevula and Uwizeyimana, 2014). However, teachers do not realise that technologies enhance face-to-face teaching, as it gives them more time to focus on learners who need more attention, reduces the number of direct instructions to learners who do not need too much assistance in class and increase their pedagogical practice (Mabila, 2017; Habibu, Al-Mamun and Clement, 2012 and Beyers and Hlala, 205). The technology also increases teachers' ICT knowledge and skills (Habibu, Al-Mamun and Clement, 2012; Mathevula and Uwizeyimana, 2014 and Beyers and Hlala, 2015). The newly acquired skills assist a teacher in using technologies to access, analyse, interpret, process and disseminate information to learners (Habibu, Al-Mamun and Clement, 2012; Mathevula and Uwizeyimana, 2014 and Beyers and Hlala,2015).

Both teachers and learners need new ways of interacting to be prepared for the changes that are happening in education. Authors such as Mabila (2017), Ndlouvu (2017); Habibu, Al-Mamun and Clement (2012) Beyers and Hlala (2015) concur that teachers need new knowledge and teaching skills, while learners need to acquire the 21st-century skills that prepare them for the working environment. Teachers need to take responsibility for their professional development and enrol in courses that prepare them for the 21st-century classroom (Mabila, 2017, Ndlovu 2017; Habibu, Al-Mamun and Clement, 2012 and Beyers and Hlala 2015). The department must also support teachers in their continuous development and provide them with conducive environments where they will be able to integrate their new skills and knowledge (Mabila, 2017, Ndlovu 2017; Habibu, Al-Mamun and Clement, 2012 and Beyers and Hlala 2015).

2.2.3 Consequences of non-integration of ICT in rural schools.

The school management plays an important role in the integration of technologies into teaching and learning. Principals should manage schools efficiently by following and adhering to all the Acts and policies that the Department of Basic Education prescribes for the management of schools (Ndlovu, 2017). It is important to note that successful integration of ICTs in schools goes beyond implementation; the school management needs to have processes and policies in place to guide the day-to-day operations and maintenance of the technologies (Beyers and Hlala, 2015). Interventions that are

implemented in schools should also be monitored to determine their intended impact on teaching and learning, to improve accountability and to influence the process in future interventions.

Access to ICTs remains a challenge in South Africa because the apartheid-era infrastructure provision was more focused on providing access and infrastructure to urban than to rural areas (Chisango and Lesame, 2017). The divide was also racial therefore there was different infrastructure provision for schools in suburban areas and township schools too. Geographical challenges render it expensive to provide ICT infrastructure in rural schools; therefore, the districts need to use the resources available to them to govern the schools effectively and efficiently (Pholotho and Mtsweni, 2016). Lack of access and availability of ICTs in schools would also not be good for learners, because they will not be able to acquire the 21st-century skills that are needed for the future 4IR demands. Teachers would also not have an interest in enrolling for ICT training if access and availability remain a challenge. The lack of knowledge and skills of teachers to use ICTs in the classroom can result in teachers having a bad attitude towards technology application in teaching and learning.

Due to the high cost of providing ICTs to schools in rural provinces, the Limpopo and Eastern Cape provinces should adopt the lessons learnt in provinces such as Gauteng and the Western Cape on how to implement mobile technologies in schools. This could save time and money for the provinces, within a context where budgets that are allocated by the national and provincial governments.to schools are earmarked for other purposes (Mabila, 2017).

The ultimate consequence of not properly integrating ICTs into teaching and learning would be a poor quality of education, learners who are exiting the education system without 21st-century skills and teachers who are not ICT literate and not willing to learn/improve their knowledge and skills to incorporate ICTs into their continuous teacher professional development.

2.3 Methods, data, findings, and conclusions studies and evaluations of implementing mobile technologies

In the previous two sections, the researcher outlined the research problem analysis (Section 2.1) by detailing the physical research context through the history of Seshego rural schools and the history of mobile technologies in Seshego. As such, this prepared the researcher for Sub-section 2.2 where a deeper understanding of the challenges experienced when mobile technologies are not integrated well into schools. To support our claims, this section interrogates previous and current studies that explored research similar to this study. The researcher interrogates the studies to establish a knowledge gap or to confirm whether it was already identified in the other sub-sections. The researcher discusses the empirical studies by pointing out the research approaches, designs, procedures and methods that such studies have employed, and the findings and conclusions that they presented. Then the researcher proposes the research approaches, designs, procedures and methods of our own research.

A significant body of literature focuses on integrating ICTs into education. The researcher reviewed eleven articles that had a similar objective to this research. Of the eleven reviewed articles, there was an article by Ghoord (2013) on technology integration into eight Polokwane secondary schools in the Limpopo province. The technology that was under study by Ghoord in 2013 is the desktop computer; our current research focuses on mobile technologies such as tablets.

Ghoord (2013) undertook a mixed methods study to evaluate technology integration efforts against existing ICT policy in eight schools in the Polokwane district. The researcher selected the schools because they were representative of the province's language and culture. Interviews, survey questionnaires and document analysis were used to collect data for the study. The study's empirical findings revealed the factors that affect technology integration into schools, namely, availability of technology infrastructure, devices, and internet connectivity; lack of training for teachers; lack of technical support; and lack of teacher involvement in decision-making relating to electronic technologies. The researcher used this finding to "establish if there is a common cause between personal, administrative and contextual elements as separate but related factors that are responsible for the poor track record of technology integration efforts in schools" (p.74). The researcher concluded that, although learners and teachers are exposed to technologies, there is no formal structure on how to integrate these technologies into

classrooms in cases such as these eight schools where there is some technological infrastructure such as desktop computers.

Another researcher, Waspe (2013), utilised the mixed method strategy to examine behavioural intentions of the district eLearning Coordinator in the Gauteng Department of Education. The researcher used interviews and survey questionnaires to gather the data. The participants were selected using convenience sampling techniques. Gauteng province has a population of.44 District eLearning coordinators in the Department of Education; the sample comprised 13 volunteers, because the remainder cited many reasons such as business and wariness of being interviewed. The findings reveal that eLearning coordinators believed that ICT efforts should be both learner- and teacher-centred. The study further discovered that the eLearning coordinators believed that ICTs could facilitate teaching and learning in schools. The researcher recommends that future studies focus on the educational district and the role that it can play to influence technology integration into schools. This study is included in the literature review because it focuses on eLearning coordinators as the drivers of policy in the districts, instead of on teachers who do not have any influence on drafting of policies.

Teachers' readiness is one of the factors that influence technology integration into schools as Ghoord (2013) has mentioned. Naicker (2017) conducted research that explored the readiness of teachers to integrate technologies in teaching and learning in the classroom, based on a qualitative research method. Two Gauteng schools were selected purposefully to be part of this case study research. The researcher used survey questionnaires and semi-structured interviews to collect the data. The empirical results showed that "there is an even split between teachers who considered themselves able to perform certain technologically-related functions and those who were unable to perform those functions" (p68). The researcher proceeded to reveal that teachers expressed a need for regular refresher training on how to integrate certain devices and software into teaching and learning. The researcher recommends that future studies that focus on teacher readiness should be of a bigger scope, to understand the extent of the lack of eReadiness for teachers to integrate ICTs in teaching and learning.

Daya (2017) carried out a quantitative research study to explore the relationship between educators' level of access to educational technologies, their attitudes towards educational technologies and their use of educational technologies for teaching related purposes. The researchers used questionnaires for data collection. This is a cross-sectional non-experimental study, because the researcher handed out questionnaires at one point in time

to a convenient sample of 119 educators from various schools in Gauteng. The empirical research findings showed that there is a lack of access to educational technology hardware such as smartboards and tablets in schools. In terms of software, teachers usually access items such as Microsoft Word and search engines at both school and home, from any of their personal smartphones, desktop computers, or laptops. The key research findings show that teachers have positive attitudes towards educational technologies; however, the levels of use and integration is low due to the varying levels of access and usefulness. Daya (2018) recommends that a mixed-methods approach be used in future studies to gather rich qualitative data that would allow for a better understanding of varying levels of access and perception of the usefulness of educational technology. Future studies could also better manage the data collection process of handing out and collection of the questionnaires. A higher questionnaire return rate is accomplished when the researcher is present during the data collection process.

In many under-resourced schools, especially in rural areas, schools have no access to basic ICT infrastructure such as the internet, computers, mobile tablets, smartboards and accompanying software. Pholoto and Mtshweni (2016) undertook a qualitative study in the Greater Tubatse Municipality to understand the challenges faced by resource-constrained schools in Tubatse. The study aims to determine how the same schools choose relevant ICTs for their own purpose, as well as investigate the state of ICT access. The researchers purposively selected 10 high schools in Tubatse due to: (i) time constraints; (ii) the higher need for ICTs in high schools than in primary schools; and (iii) the deep rural location of Tubatse. Principals and teachers in high schools were participants because they are responsible for the ICT policy implementation at the school level. The researchers conducted interviews with the participants, observed the participants in the school setting, and performed a document analysis of the schools' infrastructure plans. The empirical findings showed that Tubatse is a mountainous area with poor quality cellular and television coverage. There is a significant shortage of basic technologies such as computers and tablets. In the schools that have computers donated by the nearest mines, the computers never worked or were never fixed or maintained when broken. Teachers used computers for administrative purposes, not for teaching and learning. A lack of infrastructure made teaching and learning difficult. There is a shortage of textbooks and limited access to computers or the internet. Teachers rely heavily on textbooks for teaching computer skills; this is problematic because technology advances very fast, leaving them to rely on outdated teaching material. The researchers recommend

that future studies develop models for the delivery of digital content in resource-constrained rural areas.

Just as Pholoto and Mtsweni (2016) focused on under-resourced schools, Chigona, Chigona, Kayongo and Kausa (2010) focused on the disadvantaged communities of South Africa in their study. They investigated factors that affect technology integration into teaching and learning. The researchers randomly selected three schools that were part of the Khanya project to be part of this qualitative research. The researcher collected data through in-depth interviews with participants. The findings show that educators are not competent enough to utilise ICT in teaching and learning; as a result, there is limited use of educational technologies in delivering pedagogical content. The researchers recommend that future studies should evaluate the impact of technologies on teaching and learning.

In her Master's studies, Langenhoven (2015) focused on resource-deprived schools in the Eastern Cape. The aim was to determine how learners' experiences are influenced using tablets in teaching and learning. The researcher carried out a qualitative research study of the case of schools that were part of the Information and Communications Technology for Rural Education and Development (ICT4RED) project in the Cofimvaba district. The data collection for this research started with a pilot process, wherein the researcher finalised her data collection instruments. The learners used tablets for a short period; however, the researcher reports that there was a change in how the learners' perceived teachers. The learners were now able to access a "teacher" anywhere, anytime with the help of the tablets, and learning even took place beyond the classroom when learners used the tablets to access content on the internet and do their homework and assignments. Learners were now playing constructive educational games during their breaks; however, this could have been because the tablets were new and the learners were still excited by the technology. For future studies, researchers could evaluate the impact of technologies on teaching and learning and focus on the introduction and implementation of technologies in teaching and learning.

In 2015, Hlagala researched one of the privileged schools in the Polokwane district. The researcher described how technologies were being utilised for the teaching and learning process, and the role of teachers. This case study used qualitative research methods to collect the research data from purposively selected participants from the Grade 11 population of Curro Northern Academy. The researcher initially had meetings with Grade 11 teachers to explain the aim of the study, after which the teachers selected learners to

be part of the research. All learners in the school were provided with Edu-pads, which allowed learners to learn as they go. The learners used the Edu-pads to tailor-make their own personalised educational content depending on their needs and collaborated with one another to share the educational content that they created. The teacher's role was that of a facilitator, rather than as traditional teacher. In this process, the learners were already harnessing the 21st-century skills that allow them to compete with other learners nationally and internationally. The study also showed that learners were technologically and digitally fluent in ICTs. However, learners did not see the importance of the Edu-pads; they perceived them to be communication tools that assisted them to keep in touch with other learners, instead of realising their full potential of shifting them from traditional classrooms.

The study by the Council for Scientific and Industrial Research (CSIR)'s researchers, Herselman, Botha, Dlamini, Marais and Mahwai (2019), included a baseline survey as part of the Information and Communications Technology for Education (ICT4E) project in 24 schools in seven (7) provinces of South Africa to establish the level of ICT competence of teachers. This is a mixed methods study where the researchers handed out survey questionnaires and conducted interviews with all the participating teachers in the ICT4E project. The findings show that most teachers had a basic understanding of mobile technologies; however, none of them had ever tried to integrate ICTs in teaching and learning. During the teacher baseline survey, most teachers agreed that tablets are valuable tools in the teaching and learning process. The teachers indicated that they were not sure if they would have technical support from the district when they started to use technologies in teaching and learning. The baseline survey determined the type of training that the teachers would need, since the ICT4E project aimed to target the whole education ecosystem to understand where there are systemic weaknesses which influence technology integration into teaching and learning.

Collectively these studies show that all people (for example, researchers and policymakers) want to improve the quality of education through ICTs. However, challenges exist when it comes to technology integration into schools. These include internet connectivity, access to the technologies, lack of technical support for the teachers and lack of support from district ICT coordinators (Mabila, 2017). The major challenge with the strategic decision-makers in the Department of Education is the assumption that the e-education policy and providing technology infrastructure in schools would automatically yield

changes to the process of teaching and learning, without being properly facilitated (Mdlongwa, 2012).

The studies were conducted in the last ten years, with the oldest being done in 2010 and newest in 2019. The portfolio of research shows that researchers are constantly trying to influence and improve the quality of education through ICTs. The researchers have moved with the time from focusing on desktop computers to recent technologies such as mobile tablets. In the Capricorn district context, Ghoord (2013) did a study focusing on desktop computers; therefore, this research would interrogate the integration of mobile technologies such as tablets to determine the impact of ICTs on teaching and learning.

Studies generally adopt one of two strategies, qualitative and quantitative, as well as mixed methods, to determine the impact of ICTs in teaching and learning. However, qualitative research is more widely used, as it allows researchers to gather rich insightful information from research participants at different levels of technology integration into teaching and learning. It is for this reason that this study is qualitative in nature.

The schools in this study were purposively selected because they form part of the ICT4E project that the CSIR undertook since 2017 in 24 schools across South Africa. Data will be collected through document analysis and semi-structured telephonic interviews or via email with questionnaires. Many studies focus on ICT integration into teaching and learning; however, in this study's specific context of the Seshego circuit, no one has carried out mobile technology integration except for Ghoord (2013) who did an integration of desktop computers in teaching and learning.

Many theories can be used to interpret research results. A researcher can adopt one theory or use a combination of theories to explain how phenomena unfold in a certain context. Some theories that are used to interpret and make sense of the data from the research participants include the Theory of Planned Behaviour, Frame Theory and Theory of Reasoned Actions. Technological Pedagogical and Content Knowledge (TPCK) seems to be the most common theoretical framework that is used to interpret the results. After reviewing interpretive frameworks, this study adopts the Technology Acceptance Model (TAM) and its extension the Technology Acceptance Model 2 (TAM2) to interpret and discuss the results.

2.4 An introduction to Information and Communications Technology and its components and processes

To prepare for this section, the researcher interrogated the research context and the research problem, and finally discussed previous and current empirical studies of research like this. This has paved the way for us to introduce ICT as the broad field of our study in this section. To understand ICT comprehensively, the researcher will focus on the following areas: (i) describing the field of study; (ii) discussing some facts and issues; (iii) detailing major components; and finally (iv) outlining the major processes of Information and Communications Technology.

2.4.1 Describing Information and Communications Technology (ICT) and its purpose

The South African Department of Basic Education (2004) defines ICT as all devices, networks, software and hardware that are not only used for communication, but that allow for the analysis, management and processing of information. ICT also involves the use of technology for communicating, gathering, storing and analysing information. The communication can happen between the technologies themselves or between individuals communicating with technologies. This can include social media platforms, text messages and video calling (Mathevula and Uwizeyimana, 2014). The United Nations Educational, Scientific and Cultural Organization (n.d.) goes further to say that ICTs include other informational media, such as handheld devices, television, radio and even print media.

ICT are introduced in schools to improve the quality of teaching and learning, and the process is governed by the Department of Education's policy on e-learning (Meyer and Gent, 2016). The policy should guide the process of implementation, monitoring, operations and maintenance of ICTs in schools; however, the district and school management have no idea on how to go about implementing the policy because the department has not outlined how they should do so (Meyer and Gent, 2016). The ICT4E initiative commissioned by the Department of Education is a programme that attempts to implement the department's e-learning policy (Herselman, Botha, Dlamini, Marais and Mahwai, 2019).

The education system needs learners and teachers who are competent and skilled in ICT. With the ownership of cell phones at 95% in South Africa, learners are already ahead of their teachers as they are the "next generation". They use mobile phones from a very young age and are confidently using ICTs in their lives for communication with their

peers, research for their schoolwork and connecting to the world via the World Wide Web (Beyers and Hlala, 2015). Many teachers, on the other hand, were born before the advent of technology, and are not confident when it comes to using ICTs. They need continuous training to be confident, skilled and knowledgeable to ICTs for everyday life and for teaching and learning (Beyers and Hlala, 2015). Government needs to commit to producing teachers who are ICT competent, skilled and knowledgeable to be able to teach learners 21st-century skills, as well as improve the quality of education (Bingimlas, 2009 and United Nations Educational, Scientific and Cultural Organization, n.d., Fu, 2013 and Tondeur, Krug, Bill, Smulders and Zhu, 2015).

Generally, ICTs in education enhance the quality and improve the depth of education (Heeks, 2010, Vandeyar, 2015 and Mathevula and Uwizeyimana, 2014). "ICTs, when successfully integrated into teaching and learning, can ensure the meaningful interaction of learners with information. ICTs can advance higher-order thinking skills such as comprehension, reasoning, problem-solving and creative thinking and enhanced productivity" (South African White Paper on e-Education Department of Basic Education, 2004, p. 14). ICTs give many people access to information and allow them to communicate under circumstances that they would not be able to in the absence of technologies (Meyer and Gent, 2016 and Mathevula and Uwizeyimana, 2014). For example, people communicate via emails, voice or video calls and social media.

Technology allows for more interaction between teachers and the learners who need more help, as well as for learning beyond the classroom (Beyers and Hlala, 2015). ICT integration allows learners to collaborate with peers in other countries, and to have access to a range of resources that they would not have if they were still using traditional classrooms (Bingimlas, 2009 and United Nations Educational, Scientific and Cultural Organization, n.d.). Technology allows learners to work independently, while giving teachers time to focus on the learners who require closer attention (Bingimlas, 2009 and United Nations Educational, Scientific and Cultural Organization, n.d.). ICTs allow collaboration between learners in the classroom and supports autonomous learning, which allows learners to learn at their own pace (Mathevula and Uwizeyimana, 2014).

Schools that are under-resourced benefits from the use of ICT; they can share content online through videos, emails, social media and websites (Vandeyar, 2015 and Mathevula and Uwizeyimana, 2014). ICT allows learners to learn autonomously and require little or minimal intervention by the teacher (Vandeyar, 2015 and Mathevula and Uwizeyimana,

2014). When ICTs are used correctly, learners have a choice as to how they learn and plan their own study timetables using the ICTs (Vandeyar, 2015 and Mathevula and Uwizeyimana, 2014).

2.4.2 Some facts and issues in Information and communication technology

ICTs have spread very rapidly in both the developed and developing world (Mathevula and Uwizeyimana, 2014 and Heeks, 2010). ICTs were introduced in teaching in the 1980s and have played an important role since then (Bingimlas, 2009). However, there is a need for a deliberate process to integrate technologies into teaching and learning; simply providing ICTs will not have any impact on teaching and learning, because we cannot be certain that the teachers and learners will utilise them as intended (Chigona, Chigona, Kayongo and Kausa, 2010 and Remenyi, Lubbe and Heerden, 2000). Changing the curriculum requires that teachers be placed at the center of the process because they control the teaching and learning process (Habibu, Al-Mamun and Clement, 2012). Therefore, they should be skilled and knowledgeable on how to integrate technologies into teaching and learning.

Mobile learning technologies allow learners to access a wide variety of information that they would not have been available in traditional classrooms (Hlagala, 2015 and Pholotho and Mtsweni, 2016). Learners can collaborate and communicate with each other, exchanging information through their devices and the World Wide Web (Hlagala, 2015 and Pholotho and Mtsweni, 2016). Educational technologies are usually more expensive; ordinary disadvantaged schools cannot afford to purchase them, to carry out operations and maintenance as well as maintain the licence fees for some of the educational software (Remenyi, Lubbe and Heerden, 2000). Technology adoption requires deliberate steps to apply and use technologies for teaching and learning as soon as the technologies are available in schools (Chigona, Chigona, Kayongo and Kausa, 2010 and Remenyi, Lubbe and Heerden, 2000). Integration, on the other hand, is the deliberate absorption of technology into the process of teaching and learning in the classroom (Chigona, Chigona, Kayongo and Kausa, 2010 and Meyer and Gent, 2016). Schools will experience ICTs' impact on education when they utilise them fully in teaching and learning (Chigona, Chigona, Kayongo and Kausa, 2010, Remenyi, Lubbe and Heerden, 2000 and Habibu, Al-Mamun and Clement, 2012). The Department of Education needs a change management process to integrate ICTs.

The South African Department of Education has collaborated with many entities to integrate ICTs into teaching and learning. However, the department is not really at the forefront with this; hence, implementation of ICTs in teaching and learning is sporadic (Vandeyar, 2015 and Meyer and Gent, 2016). This sentiment is echoed by Pholotho and Mtsweni (2016), who have observed that the Department of Education has collaborated with other government departments and Non-Government Organisations (NGOs) such as SchoolNet and other stakeholders, to introduce ICT in teaching and learning and decrease the use of traditional teaching and learning techniques.

Deploying ICTs in education faces many challenges, for example a lack of stable electricity supply and security, the cost of deployment and maintenance, and a lack of technical expertise and support for the teachers (Pholoto and Mtshweni, 2016). In addition, there are no dedicated teacher training courses for teachers to use and integrate technologies into teaching and learning (Mathevula and Uwizeyimana, 2014). The attitude of teachers towards ICTs also plays a role when it comes to ICT integration into teaching and learning; teachers need to be supported by the schools and districts to integrate technologies, and their KPIs need to be updated to include the use of ICTs as part of their performance indicators (Mathevula and Uwizeyimana, 2014 and Pholotho and Mtsweni, 2016).

The rollout of technology does not guarantee an improvement of the quality of education; the department needs a dedicated implementation plan on how the ICTs are integrated into teaching and learning (Meyer and Gent, 2016). The department should have a systematic way to integrate technologies into teaching and learning, as this would eliminate the confusion between districts and schools on who is responsible for what in the implementation of ICT in schools.

2.4.3 Components of Information and Communications Technology

This study adopts the description of a component as "'independent parts of the whole" (Wotela, 2017, p.145). The major components of ICT are information, communications and technology. This refers to "the hardware, software, networks and media for the collection, storage, processing, transmission and presentation of information (voice, data, text, images), as well as related services" (Mathevula and Uwizeyimana, 2014, p1087). The United Nations Educational, Scientific and Cultural Organization (n.d.) goes further to include other informational media, such as handheld devices, television, radio, print media, telephones and networks.

Information is any data that can be recorded by typing words, voice records or video recording (voice, data, text, images) that are stored, analysed and processed (Mathevula and Uwizeyimana, 2014).

Communications is the connection between computers, phones, users and software through the internet and the World Wide Web (United Nations Educational, Scientific and Cultural Organization, n.d.).

Technology is computing hardware, systems and devices (such as desktop PCs, laptop computers, tablet computers, interactive whiteboards, simulation system and immersive environment) (Ngobeni, 2017). Figure 2.4 shows ICT with its identified components.

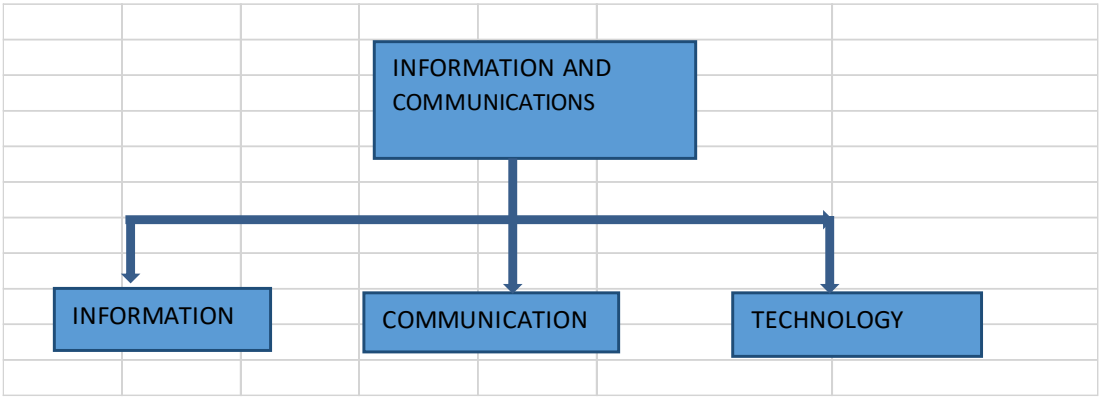

Figure 2.4. Components of Information and Communications Technology (Source: Author)

2.4.4 Processes in Information and Communications Technology

The United Nations Educational, Scientific and Cultural Organization (n.d.) defines the processes of ICT as initiation, implementation, and institutionalisation, which covers a system-wide innovation. Meyer and Gent (2016) added the policy underpinning the processes of ICT, while Heeks (2010) added the evaluation of impact as well as the sustainability of the implemented ICT processes.

When executing the processes underlying ICT implementation, the relevant stakeholders have to make sure that the schools are ready for the processes, and that they have the ICT infrastructure as well as a plan of how processes of ICTs will be implemented in the schools (Meyer and Gent, 2016). The implementing stakeholder should make sure that teachers will be trained in accordance with the national ICT policy, and that all stakeholders understand and know their roles and responsibilities for the ICT processes implementation (Heeks, 2010 and Meyer and Gent, 2016).

Heeks, 2010, Meyer and Gent, 2016 and the United Nations Educational, Scientific and Cultural Organization (n.d.) together outline the processes of ICT as initiation, design, implementation, institutionalisation and evaluation.

Initiation: This is the first process when it comes to ICT implementation. First start by defining the vision and strategy for ICTs, then state the aspect of the education system that is targeted, followed by how that ICT policy would be implemented (Heeks, 2010, Meyer and Gent, 2016 and United Nations Educational, Scientific and Cultural Organization, n.d.). Before moving on to the next stage in the process, there is an update all the relevant documentation, address how administrative staff will assist with ICTs in teaching and learning, and then do a readiness assessment to ascertain that the schools are ready for ICT integration (Heeks, 2010, Meyer and Gent, 2016 and United Nations Educational, Scientific and Cultural Organization, n.d.).

The second stage in process of ICT integration involves design; this means proposing or developing new improved applications of technology in teaching and learning (Heeks, 2010, Meyer and Gent, 2016 and United Nations Educational, Scientific and Cultural Organization, n.d.).

Implementation involves upskilling the district to support the implementation of ICTs, procurement of ICT infrastructure, or upgrading of existing infrastructure at schools (Heeks, 2010, Meyer and Gent, 2016 and United Nations Educational, Scientific and Cultural Organization, n.d.). In addition, state the roles and responsibilities of all stakeholders, and then train the teachers on how to integrate technologies into teaching and training (Heeks, 2010, Meyer and Gent, 2016 and United Nations Educational, Scientific and Cultural Organization, n.d.).

During the Institutionalization stage, the different progress markers for the schools is defined, which will be used to measure the progress, outcomes and impact of the ICT on teaching and learning at the evaluation stage (Heeks, 2010, Meyer and Gent, 2016 and United Nations Educational, Scientific and Cultural Organization, n.d.).

The final stage in the ICT processes is evaluation. This involves measuring the progress of the implementation and measuring the outcomes as well as the impact the ICTs have had on teaching and learning as well as the whole education system, starting from the district level (Heeks, 2010, Meyer and Gent, 2016 and United Nations Educational, Scientific and Cultural Organization, n.d.). During evaluations, track changes in the education system that could either be attributed to the ICT or to other influences.

The diagram below depicts the processes that were discussed above, starting with initiation, design as per specifications of the school, implementation of the technologies in teaching and learning and then proposing policies that make sure the ICTs are institutionalised in schools (Heeks, 2010, Meyer and Gent, 2016 and United Nations Educational, Scientific and Cultural Organization, n.d.). Finally, evaluation involves measuring the impact of technologies in teaching and learning, as well as school administration (Meyer and Gent, 2016).

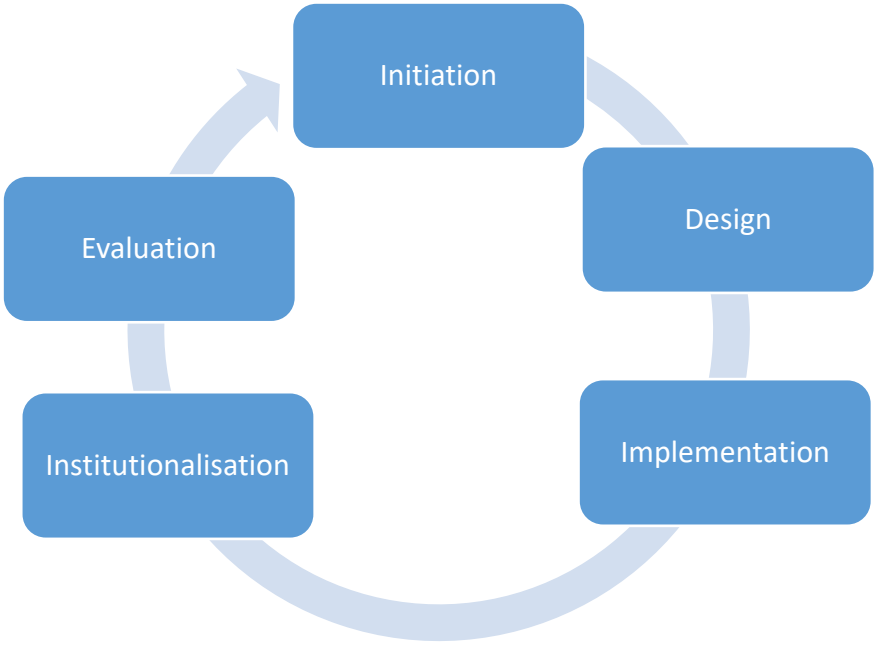

Figure: 2.5. Processes of Information and Communications Technology (Source: Author)

2.5 Attributes and variables in ICT are key to the success of an intervention

In the previous section, the researcher introduced Information and Communications Technology as our broad field of study. Then discussed the field until identifying the major components, namely, information, communications and technology. This study is about mobile technology evaluation; therefore, the researcher examines technology as a field of study in more detail in this section, to assist us in identifying its attributes and variables. These variables and attributes will assist us in drafting the data collection instrument and answering the research questions. "Attributes or variables—defined here as elements or features on which one can collect information (attributes) or data

(variables) that can be processed to answer research questions or test hypotheses or prove propositions" (Wotela, 2016, p. 151). An attribute is used in qualitative research to gather information, while a variable is used in quantitative research to gather data.

First step is a discussion of hardware and software as the identified attributes and variables; then briefly describe the attributes and variables; show how they interlink with each other and point out how they will assist us in answering our research questions. This section is concluded with detail on sources of information for these attributes and variables.

Using literature, the researcher has decoded the attributes and variables of technology, such as software and hardware, as depicted in Figure 2.6. The researcher did not want to delve immediately into technology and identify it as a field of study, because there is a need to show the link between ICT, technology and finally the identified variables of software and hardware.

Figure 2.6 shows ICT as a field of study. Information, communications and technology are identified as the components of ICT, with the help of authors such as the United Nations Educational, Scientific and Cultural Organization (n.d.), Pholotho and Mtsweni (2016) and Mathevula and Uwizeyimana (2014). Figure 2.6 outlines the components of technology as software and hardware.

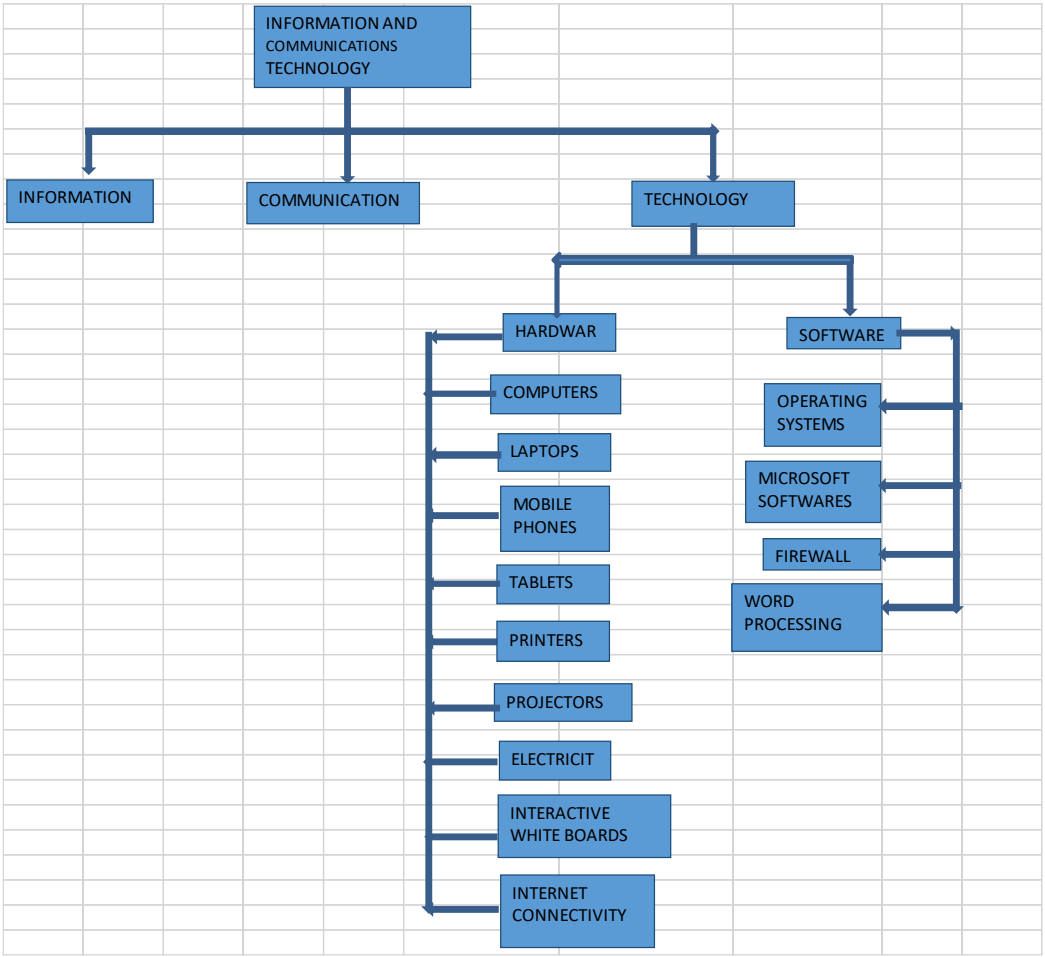

Figure: 2.6. Components of ICT with components of Technology (Source: Author)

2.5.1 Technology Hardware

Technology hardware is the collection of all the parts that you can physically touch. Hardware includes all the types of devices (e.g., laptops, desktops, smartphones, printers, interactive whiteboards) (Mathevula and Uwizeyimana, 2014). Authors such as Chigona, Chigona, Kayongo and Kausa (2010) describe hardware as the infrastructure required for the use of ICTs in teaching, including physical space, furniture, electricity and internet connectivity. Shunmugam (2015) views technology from an education perspective and describes hardware as all electronic devices that can be used in teaching and learning as well as school administration.

Technology devices are designed to establish or improve on existing communication between devices or people (Shunmugam (2015). In addition, the hardware is used to store, retrieve and manipulate information to suit our needs (Mathevula and Uwizeyimana, 2014). In the field of education, technology assists in developing learners' reasoning, understanding and the creative capacity into which teachers would not be able to tap

without innovative devices; these capabilities are better learned when using interactive media (Chigona, Chigona, Kayongo and Kausa (2010).

Computers, tablets, laptops, internet connectivity, smartphones, internet, and photocopy machines are the common components identified by authors such as Shodhganga (2015), Asabere (2013) and Mathevula and Uwizeyimana (2014). Other authors add internet connectivity, and the connection to a network infrastructure that allows communication between devices and device users (Asabere, 2013, Chigona, Chigona, Kayongo and Kausa, 2010 and Beyers and Hlala, 2015).

This attribute assisted us in drafting questions related to the manner of integration of mobile technologies into teaching and learning, since tablets were deployed in the schools. The researcher asked questions related to the preparations that were made in the school for teaching and learning with mobile technologies. What type of mobile technologies were used into teaching and learning? How and why did they integrate technologies into teaching and learning? The researcher also asked about the type of training the teachers had before they started integrating mobile technologies into teaching and learning, and whether they felt sufficiently equipped to integrate the technologies.

2.5.2 Technology Software

Technology Software is a technology component that one cannot touch physically. Rouse (2020) describes technology as "a set of instructions, data or programs used to operate computers and execute specific tasks". The software can be divided into many categories, such as operating systems, applications software, Firewall software, word processors, and others (Rouse, 2020). In information technology, infrastructure refers to the software, hardware and their underlying processes (Beyers and Hlala, 2015).

Each type of software serves a specific purpose. An operating system, for example, controls all the programs in a computer (Rouse, 2020). Software such as spreadsheets and word processors manipulate text to allow information to be processed, stored, classified and sorted (Smith, 1989). Software such as firewalls prevent technology software from malicious access to the system (Smith, 1989).

While some people would understand what software is, others might not know; however, most people understand that technology hardware will not function unless equipped with various applications and software. People would know about software such as the Microsoft Office suite but might not know that the generic name is software. This attribute assisted us in understanding the types of software that teachers use for teaching

and learning, the types of software that stimulate learners' minds in further developing their ICT skills and the reasoning behind choosing specific software. The data collection process is the same as for the previous attribute. The data sources and data analysis process will also be the same.

2.6 ICT frameworks for interpreting empirical results in measuring success

In Section 2.4, the researcher identified ICT as our broad field of study. Then interrogated ICT until identifying the attributes and variables (which are technology and software) in Section 2.5; these will assist in gathering data for the research. To change the research results into research findings, discuss and interpret the results through the lens of relevant ICT interpretive frameworks. Th interpretive frameworks explain the process of technology use and integration into teaching and learning.

In Section 2.6.1, interpretive frameworks of technology use, adoption and acceptance or rejection are interrogated. Current and previous literature is reviewed to identify the pioneer, antagonists and supporters of each model. Interpretive frameworks can be described as a framework, model, construct or theory that can be used to explain the research findings of a study (Wotela, 2016). Each model is then discussed under these themes: the events that led to the development of the chosen interpretive frameworks, how they were developed and the initial purposes for each interpretive framework's development. The researcher concludes the discussion of each interpretive framework with the advantages and disadvantages presented in literature for each model.

In Section 2.6.2, the researcher selects an interpretive framework or a combination of frameworks that would apply to this study and explain how the model would be applied to explain technology use, acceptance/rejection and integration into teaching and learning.

2.6.1 Theories of Technology use, acceptance and integration into teaching and learning.

The TAM, formulated by Davis in his PhD studies in 1986, is the basis for all models and theories that explain the use and acceptance of technology in education (Sargolzaei, 2017). The researcher will start this section by interrogating how Davis's theory came about, and then go on to interrogate other models that were developed to add more variables to better explain technology use and acceptance.

Most academics use TAM as their base model for understanding human behaviour towards technology acceptance or rejection within the process of teaching and learning (Sargolzaei, 2017). Some scholars, for example, Venkatesh (2000) added more variables to the TAM and created another model to further explain technology acceptance and use in teaching and learning. The researcher will detail TAM as well as all the subsequent models that were proposed, based on TAM.

2.6.1.1 Technology Acceptance Model (TAM)

In his doctoral studies in 1986, Davis proposed the TAM. He analysed and improved the Theory of Reasoned Action (TRA) that was created by Fishbein and Ajzen (1975) (see also Ajzen and Fishbein, 1980). The Theory of Reasoned Action is a psychological theory that explains human behaviour, to develop an understanding of predictors of human behaviour towards potential acceptance or rejection of a phenomenon (Granić and Marangunić, 2019). Although a good model of explaining human behaviour, TRA does not specify the context through which human behaviour is understood. Researchers using the model must first identify their research context before they utilise the model; it is for this reason that Davis developed a model that specifically explains human behaviour in the context of information systems to predict information technology acceptance and usage (Davis, 1986 and Sargolzaei, 2017).

TAM has two main objectives. First, it assists researchers in understanding the user acceptance process to develop new ways of designing and implementing technologies in teaching and learning (Davis, 1986). Second, TAM should provide researchers with an opportunity to evaluate new systems before they are implemented (Davis, 1986). Adams, Nelson and Todd (1992) agree that TAM can also be used to get feedback from users about an implemented technology solution. In addition, Bagozzi (2007) added that TAM explains human decision-making towards the use or rejection of technology.

TAM theorizes that an individual's behavioural intention to use a system is determined by two beliefs: perceived usefulness (PU) and perceived ease of use (PEOU) (Davies and Venkatesh, 2000). Perceived usefulness is defined as "the extent to which a person believes that using the system will enhance his or her job performance, and perceived ease of use, defined as the extent to which a person believes that using the system will be free of effort" (Davies and Venkatesh 2000, p187). However, there is more to understanding the reasoning behind why people use a system, besides their perception of how easy it is to use a system and how useful the system is. Granić and Marangunić (2019) add that

attitudes towards the system will determine whether people's behaviour towards an information system changes.

Figure 2.7 shows a diagrammatic representation of TAM, as described by Davis (1989). According to TAM, the attitude towards a system is a major influence on whether they use the system or not. The attitude in turn influences the perceptions of individuals towards the system.

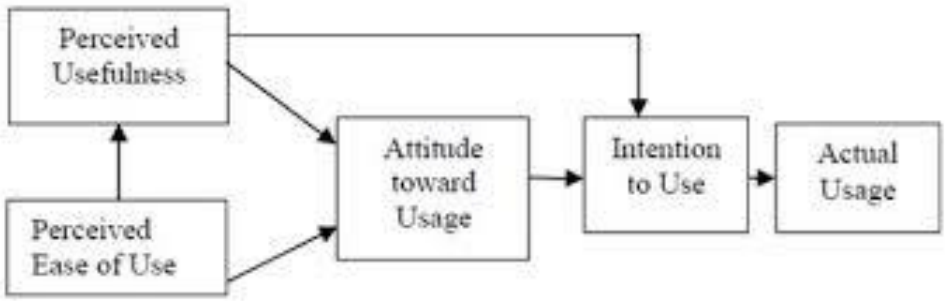

Figure 3. The technology acceptance model (Davis, 1989).

Figure: 2.7. Technology Acceptance Model (Source: Davis, 1989)

TAM is one of the first models that predicted how people would behave towards information systems in terms of accepting or rejecting the system (Sargolzaei, 2017). TAM assist researchers with investigating and understanding the acceptance of learning technology by students, teachers and other stakeholders (Granić and Marangunić, 2019). TAM can be applied to many fields (Venkatesh, 2000). Different acceptance studies have been exploring TAM's applicability to different learning technologies, such as mobile learning (Granić and Marangunić, 2019). Although TAM does not include how factors such as age, gender, and culture affect technology acceptance, it has been applied to many other fields to explain how people accept or reject systems (Sargolzaei, 2017).

TAM assumes that systems' use depends on the users while, in fact, people are "forced" to utilise the systems that management puts in place to improve their workplaces (Adams, Nelson and Todd, 1992). System usage is usually part of a job requirement. TAM explains why people reject or accept a system; it does not offer developers a solution as to how to improve or adapt a system to suit the users and others in a different context (Venkatesh, 2000 and Bagozzi, 2007). Davis' more recent work acknowledges this potential limitation: "While being very powerful in helping us predict acceptance, one of the limitations of TAM is that it does not help understand and explain acceptance in ways that guide

development beyond suggesting that system characteristics impact ease of use" (Venkatesh, 2000, p.344).

2.6.1.2 Technology Acceptance Model 2 (TAM2)

TAM2 is very similar to TAM; it simply added more constructs to understand the reasoning behind why people accept or reject technology. Venkatesh and Davis proposed TAM2 in 2000; the researchers used TAM as their base model, and then "incorporated additional theoretical constructs spanning social influence processes (subjective norm, voluntariness, and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability, and perceived ease of use)" (Venkatesh and Davis, 2000, p.187). TAM2 explains the reasoning behind people's technology acceptance using additional constructs, namely, job relevance, output quality, results in demonstrability and perceived ease of use (Sargolzaei, 2017). TAM2 adds other factors that can influence the use or rejection of technology, namely, subjective norm, voluntariness and image (Venkatesh and Davis, 2000).

2.6.1.3 Unified Theory of Acceptance and Use of Technology (UTAUT)

The UTAUT model was developed by Venkatesh et al. (2003), resulting from a synthesis of eight different theories of technology acceptance, diffusion and use: (i) the theory of reasoned action (TRA); (ii) the TAM; (iii) the motivational model (MM); (iv) the theory of planned behaviour (TPB); (v) the combined theory of planned behaviour/technology acceptance model (C-TPB-TAM); (vi) the model of personal computer utilization (MPCU); (vii) the diffusion of innovation theory (DOI); and (viii) the social cognitive theory (SCT) (Venkatesh, Morris, Davis and Davis, 2003, Khechine, Ndjambou and Lakhal, 2016 and Udo, Bagchi and Maity, 2016).

UTAUT emphasises the understanding of context to explain technology acceptance. Venkatesh et al. (2003) designed the UTAUT model to comprehensively understand and predict the behaviour of users' behaviour which could not be done by other existing models (Khechine, Ndjambou and Lakhal, 2016). UTAUT aims to explain technology acceptance in many contexts, including e-learning in the education context (Mahande and Malago, 2019). The UTAUT model identifies the re-labelling of the four final constructs of performance expectancy, effort expectancy, social influence, and facilitating conditions as theoretical predictors of behavioural intention and underlying behaviour (Wedlock and Trahan, 2019). Experience, voluntariness, gender and age are crucial constructs of UTAUT (Venkatesh et al., 2003). UTAUT has combined eight models' weaknesses and

turned them into strengths for its application in technology acceptance. The UTAUT model highlights the importance of contextual analysis and how it helps in the development of organizational technology implementation (Wedlock and Trahan, 2019 and Venkatesh et al., 2003).

A weakness of UTAUT is that it has too many variables that explain human behaviour towards technology acceptance. This can be confusing and can give inconsistent results when used to predict technology adoption/acceptance/rejection (Thomas, Singh and Gaffar, 2013). Udo, Bagachi and Maity (2016) have identified a problem with the original questionnaire that was used to propose UTAUT, since the items used addressed the frequency of planned behaviour. Therefore, the measures for UTAUT should be viewed as preliminary, and future research should be carried out to explain how all variables influence each other to explain human behaviour with regards to technology adoption/acceptance/rejection (Venkatesh et al., 2003).

2.6.1.4 Technological Pedagogical Content Knowledge Framework (TPCK)

In 2006, Mishra and Koehler formulated the technological, pedagogical and content knowledge (TPACK) framework. This was an extension of Shulman's (1986) model which emphasised the role of technology on teaching and learning (Koehler, Mishra, Kerelui, 2013). The researchers identified the major components of TPACK as "(i) Content knowledge (CK) which refers to any subject-matter knowledge that a teacher is responsible for teaching; (ii) Pedagogical knowledge (PK) refers to teacher knowledge about a variety of instructional practices, strategies, and methods to promote students' learning; and (iii) Technology knowledge (TK) refers to teacher knowledge about traditional and new technologies that can be integrated into the curriculum" (Koehler, Mishra, Kerelui, 2013, p.102). Figure 2.8 depicts the TPCK model.

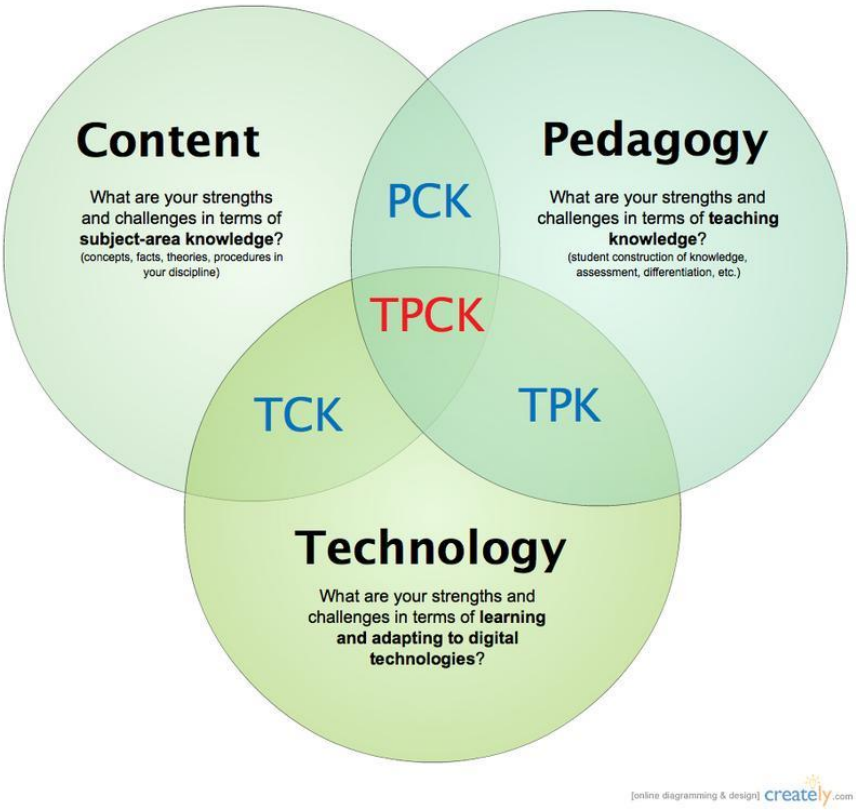

Figure: 2.8. The TPCK Model (Source: Naczi, 2018)

Teachers must understand technology, understand how it works and understand how to integrate it in teaching and training in order to fully utilise it for teaching and learning in classrooms; that is, when technology is integrated into instruction, technological pedagogical content knowledge is an important requirement (Lee and Tsai, 2008).

The TPCK framework addresses the problem that arises from ICT courses' focus on ICT knowledge without considering the subject content as well as pedagogical training of teachers (Chai, Koh and Tsai, 2013). When ICT training courses are designed, the pedagogical content must be taken into consideration to make it easy for teachers to incorporate both their technological and pedagogical skills when teaching. The TPCK model argues that teachers' understanding of technology need to be related to their understanding of pedagogy and content (Howard and Maton, 2011). As a framework, it has been engaged to understand how to use and integrate technologies in teaching and learning, to influence how teacher curriculum is planned,developmed and implemented and influence the process of applying and using technologies in teaching and (Polly et al., 2010). TPCK is useful in teacher training, as it guides how teachers should be trained to effectively and efficiently use technologies in their process of teaching and learning (Howard and Maton, 2011).

TPCK does not account for other goals of education that do not include technology and does not give detail on the type of technological knowledge that needs to be added to teacher training for them to integrate technologies in teaching and learning (Koehler, Mishra, Kerelui, 2013).

2.6.2 Theories that can explain technology integration into teaching and learning.

The models discussed explain technology acceptance, rejection, adoption and integration. These are models used by information systems experts to interpret their research results. The attributes and variables that were identified will assist us in formulating questions that establish the process of technology integration into teaching and learning; these models (especially the TAM and TAM2) will be used as the interpretive models that explain how teachers use and integrate technologies in the process of teaching and learning. TAM was selected as the interpretive framework for this study because it is flexible and allows for the addition of other constructs to predict the use and acceptance of technology.

In the intervention plan of the ICT4E initiative, learners were not trained to use mobile technologies; therefore, they had excluded them from the study. In terms of teachers, the researcher wanted to determine how the planned training assisted them in using and integrating the technologies in teaching and learning, and how their technology knowledge has assisted them in teaching using mobile technologies. TAM and its extension TAM2 were used to interpret the research results. For this research, the researcher adopted the definitions of the TAM and TAM2 extension constructs in Table 2.1.

Table 2.1 TAM and TAM1 extension constructs

Model	Construction	Definition
TAM basic constructs	**Perceived Ease of Use**	**The degree to which a person believes that using a particular system would be free of effort.**
	Perceived Usefulness	**The degree to which a person believes that using a particular system would enhance his or her job performance.**
	Subjective norm	**Individual's perception that most people who are important to her/him think s/he should or should not perform the behaviour in question.**
	Image	**The degree to which use of an innovation is perceived to enhance one's image or status in one's social system.**
TAM2 - Additional constructs	**Job relevance**	**An individual's perception regarding the degree to which the target system is applicable to his or her job.**
	Output quality	**The degree to which those tasks match their job goals; people will take into consideration how well the system performs those tasks.**

	Results demonstrability	**The tangibility of the results of using the innovation, including their observability and communicability.**
	Computer self-efficacy	**An individual's ability to apply his or her computer skills to a wider range of computer related tasks". Therefore, computer self-efficacy represents an individual's perception of his abilities to use computers to perform a task.**
	Perceptions of external control	**The degree to which an individual believes that organizational and technical resources exist to support the use of the system.**
	Computer anxiety	**The degree of "an individual's apprehension, or even fear, when s/he is faced with the possibility of using computers**

Table 2.1 TAM and TAM1 extension constructs. (Source: **Sargolzaei (2017, p181))**

2.7 Effectiveness of mobile technology interventions in rural schools: The case of the Seshego circuit in the Polokwane district — a conceptual framework

This section introduces the conceptual framework that will guide the research. The conceptual framework is a summary of the key points in Sections 2.1 to 2.6 which in turn, are a summary of literature reviewed for the derivation of a conceptual framework. The latter provides the structure of the research report and serves as the blueprint of the research; these sections provide a sequence of events that led to the findings. They show the link between the different components of a research report. Regardless of the type of research, a conceptual framework is important for direction on how the different components are linked.

A conceptual framework is a stand that a researcher adopts for exploring, interpreting and explaining the relationships between events (Imenda, 2014). It is the researcher's idea on how their research problem is explored. It explains the relationships between all concepts in research. Researchers can design their own conceptual frameworks, but this has to be rooted in literature.

Scholars have different views on what a conceptual framework is. Ravitch and Riggan (2012, p. 7) define a conceptual framework as an "argument about why the topic one wishes to study matters and why the means proposed to study it are appropriate and rigorous". To convince others that a research topic is worth pursuing involves the resolution of the everyday issues that people are faced with.

The interrogation and discussion of the physical research context has revealed that infrastructure provision, specifically ICT infrastructure, is a problem in rural schools (Beyers and Hlala, 2015). These schools are faced with a choice between technology and

other needs such as sanitation, water, proper buildings, desks, chairs and books (Polokwane local municipality, 2016 and Ngobeni, 2017). Another key problem presented in the research context is that there is no proper plan on how to implement the Department of Basic Education's e-learning policy (Vandeyar, 2015, Maboya, 2018 and Mabila 2017). In most cases, schools are provided with technologies without proper training on how to use them in teaching and learning (Mdlongwa, 2012).

The ICT4E intervention, which will be evaluated in this study, has been implemented differently from all other ICT interventions in schools due to lessons learned from previous interventions in rural schools. The latter include lessons from the ICT4RED intervention, which aimed to effect a system-wide change to influence the use and integration of mobile technologies in teaching and learning (Herselman, Botha, Dlamini and Maremi, 2019 and Matyila, 2019). The intervention focused on changing the school ecosystem, from the education officials in the department to the learners in schools (Herselman, Botha, Dlamini and Maremi, 2019 and Matyila, 2019). The intervention had several deliverables, one of them being teacher professional development (Herselman, Botha, Dlamini and Maremi, 2019 and Matyila, 2019). This training is meant to support teachers as accredited ICT training for the use and integration of technologies into teaching and learning. This research focuses on how the training and intervention have influenced teachers' behaviour towards the use and integration of mobile technologies in teaching and learning. The focus is on the teachers, because they are placed at the heart of teaching and learning in schools; without them, no education is possible.

The reviewed literature did not reveal any studies of this nature in the Seshego circuit rural schools; this provides us with the physical setting knowledge gap. None of the many studies on the integration of technologies into teaching and learning (especially in the Seshego circuit) has had an opportunity to evaluate an intervention like the one implemented in the identified schools. Ghoord (2013) carried out a study that determined the integration of technologies into teaching and learning; however, the focus was on desktop computers. This represented an opportunity for this study to focus on mobile technologies such as tablets. Ghoord (2013) did not do an evaluation of any intervention; instead, the focus was on the ICT infrastructure that was already available in schools.

The main outcome of the intervention is to improve the quality of education in South African rural schools (Herselman, Botha, Dlamini and Maremi, 2019 and Matyila, 2019). This objective is achieved through provision of ICT infrastructure, training teachers on how to integrate mobile technologies into the teaching and learning process, and training

education officials on how to support teachers and learners in ongoing use of mobile technologies in classrooms for teaching and learning (Herselman, Botha, Marais, Dlamini and Mahwai, 2019 and Matyila, 2019). The research opportunity is to conduct a summative evaluation of the intervention to determine if the outcome of technology integration was achieved, and to assess if it can be attributed to the intervention or other factors.

Most past and present studies adopted a qualitative research strategy; hence, this incumbent study also adopts the same. Although the intervention under review targeted more than one province, the researcher decided to focus on one area as a case in order to get insightful accounts of how mobile technologies are integrated into teaching and learning. In the analysis of the past and present studies, most researchers utilised the Technology Pedagogical Content Knowledge framework. However, the Technology Acceptance Model was used, as it addresses our attributes and variables better.

This research is grounded in ICT as a broad field of study. ICT has three major components, namely, information, communications and technology (Pholoto and Mtsweni.2016). This incumbent study is situated under technology as a field of study. Two key components were derived that would assist in gathering data, namely, technology hardware (Pholoto and Mtsweni, 2016) and software (Rouse, 2020). These attributes will assist in answering the research questions, and in identify relevant interpretive frameworks that can be used to make sense of the data through a discussion that is based on the framework.

Initially, the plan was to visit schools to collect data; however, due to the current COVID-19 pandemic, the researcher schedule telephonic interviews to gather data and share email questionnaires to include teachers who were unable to do telephonic interviews. Although classroom observations and learner interviews would have provided rich data on how teachers and learners interact with technologies from the researcher's point of view, this was unfortunately not possible due to restricted access to schools because of the pandemic. Project documents were reviewed to see how they can contribute to the incumbent study. Using the attributes and variables identified earlier, participants were asked if they know what technology hardware and software are. This served to clear any confusion for the people who do not know what hardware or software is.

As pointed out previously, the interpretive frameworks that are used by most past and present studies are TPCK and TAM. However, these are not the only interpretive

frameworks that researchers use to interpret their results. Others include the Technology Acceptance Model 2 and the Unified Theory of Acceptance and Use of Technology (UTAUT) models; however, these will not be used in this incumbent study.

The Technology Acceptance Model and Technology Acceptance Model (2) were used as the interpretive frameworks for the study to explain the use and integration of mobile technology into teaching and learning. Some constructs, which emanate from the models, are perceived ease of use, perceived usefulness, and computer anxiety. These were used to understand how teachers accept, reject, or use technology for teaching and learning. Figure 2.9. represents a visual representation of the conceptual framework.

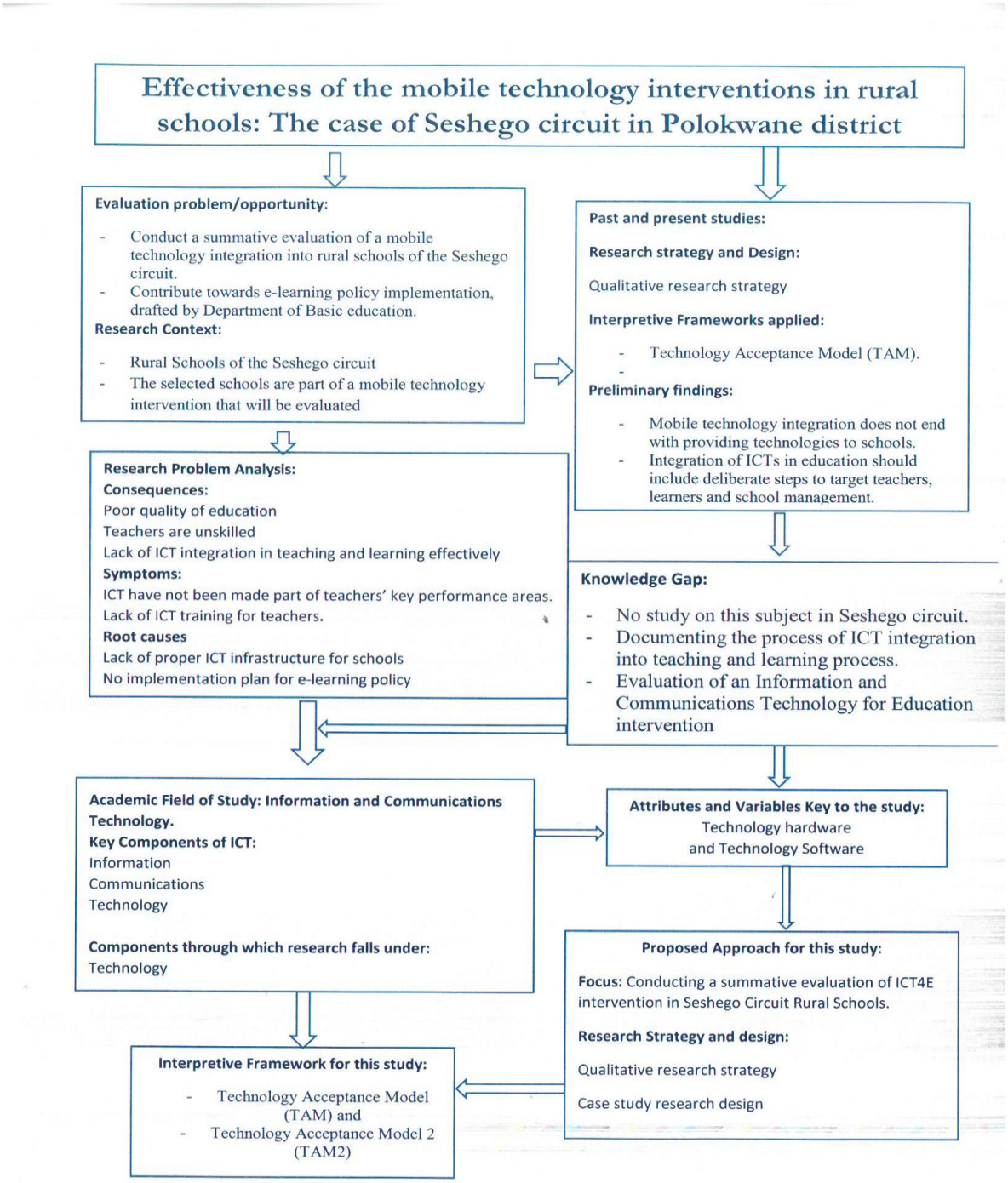

Figure: 2.9. Conceptual Framework for this study (Source: author)

Figure: 2.9. Conceptual Framework for this study (Source: author)

This chapter presented the literature reviewed to determine first, to understand the research problem, second to identify the knowledge gap, third to develop a theoretical framework for interpreting the findings and present the conceptual framework for carrying out this research. In this chapter the researcher presented the research context of Seshegocircuit rural schools where the research takes place. Then the research presented what the main problem is when it comes to technology use and integration in these schools. In addition, the research focused on other studies which are similar to this research to determine what the issues are and how they were solved and how that can assiust this study solve the problem in Seshego rural schools. This study is grounded in information and communications technology and interpretive frameworks relevant to the field of study were identified which will assist in interpreting the research results in chapter 5 when the results are discussed. The section closed of with a conceptual framework which guides how the study will take place, this prepared the way for discussion of the research strategy, design, procedures and methods in the next chapter.

3 RESEARCH STRATEGY, DESIGN, PROCEDURE AND METHODS

In Section 1.2.3, the researcher has posed four questions that this research report intends to answer, namely, (i) how can monitoring and evaluation support mobile technology integration into schools; (ii) what is the importance of measuring the impact of mobile technologies in schools; and (iii) how can mobile technologies be integrated into teaching and learning? (iv) what were the intended out comes of the ICT4D intervention in terms of teachers? The researcher has since reviewed literature and develop an interpretative as well as a conceptual framework to guide the choices of the study techniques. This chapter identifies and describes the research approach, design and the procedure and methods that are employed to collect, process, and analyse empirical evidence. It has three objectives, namely, to identify and describe the research strategy (Section 3.1), the research design (Section 3.2), and the procedure and methods (Section 3.3). The chapter also describes the reliability and validity measures (Section 3.4) that this research applied to make it credible, and the technical and administrative limitations of the choices that are made (Section 3.5).

3.1 Research strategy

A research strategy is the plan of how a research process proceeds (Bryman, 2012 and Nayak and Singh, 2015). This plan involves several decisions that need to be taken, for example, which research strategy to use, which research procedures and methods to employ, and which data collection, analysis and interpretation methods to employ for a particular study (Cresswell and Cresswell, 2018, Nayak and Singh, 2015 and Bryman, 2012). There are various types of research strategies, namely, quantitative, qualitative, mixed methods research, arts-based research, and community-based participatory research (Leavy, 2017). The most used are qualitative, quantitative and mixed research strategies (Bryman, 2012 and Cresswell and Cresswell, 2018).

This study employed a qualitative research strategy. Words rather than quantification were used during data collection and analysis processes (Bryman, 2012). The strategy focuses on understanding people's realities from their own perspective (Leavy, 2017). Taylor, Bogdan and DeVault (2016) add that qualitative researchers identify with the people who participate in their study in order to understand how they create their realities. Qualitative researchers study the reality of the research participants in their own environment (Bryman, 2012 and Leavy, 2017). For qualitative researchers, social reality is constructed

and changes over time and as contexts and situations change during the different stages of life (Bryman, 2012 and Nayak and Singh, 2015). Qualitative researchers study things in their natural settings, attempting to make sense of, or to interpret, phenomena in terms of the meanings people bring to them (Nayak and Singh, 2015, Leavy, 2017 and Bryman, 2012). Qualitative research methods are designed to help researchers understand people and the social and cultural contexts within which they live (Chigona, Chigona, Kayongo and Kausa, 2010). This study benefitted from this type of strategy because the data collection resulted in an accumulation of rich insightful information from research participants. The researcher understands mobile technology integration from the perspectives of the participants in the respective schools. The researcher also captured what meanings and reality teachers attach to mobile technology integration into rural schools.

In recent ICT in Education studies, various researchers have used a qualitative research strategy in their respective research to make sense of how technologies affect the educational process. In 2015, Beyers and Hlala undertook a qualitative research study to evaluate how e-learning can change the face of education in the Nokotlou, Lebowakgomo and Polokwane circuits of the Capricorn district of the Department of Education. This strategy was selected because they were able obtain descriptive accounts of experiences from respondents on how the e-learning policy has been implemented in the schools, as well as interact with them in their own contexts. Interacting with research participants in their contexts is beneficial, because people are relaxed and sometimes share information that they would not share on a different context. In this study, the researcher would get descriptive accounts of mobile technology integration experiences from respondents who were part of the ICT4E initiative from the beginning. The researcher would be able to create meaning, based on the experiences of the respondents.

Chigona, Chigona, Kayongo and Kausa (2010) also carried out research based on a qualitative research strategy with the aim of investigating the factors that affect the integration of ICTs into teaching and learning. Qualitative research helps researchers to understand people and the social and cultural contexts within which they live. This strategy allowed the researchers to study the participants in their own environments to gather insightful information that would contribute to identifying factors that affect the integration of ICTs into teaching and learning. This strategy uses multiple realities to construct meaning in social realities (Rahman, 2016). Our study will exploit the benefits associated with the use of a qualitative strategy.

Pholoto and Mtsweni (2016) undertook a qualitative study in under-resourced schools of the Greater Tubatse Municipality with the aim of investigating the state of access to ICT infrastructure in the schools, to determine what educational content and services the schools need and to document the ICT infrastructure challenges faced by the schools (see Section 2.3). The strategy was selected because it offers the researchers an opportunity to gather rich insightful data from cultural, social and political angles of the participants. The researcher will be able to understand mobile technology integration from the perspectives of the participants in the respective schools.

For this evaluation of mobile technology integration into the rural schools of the Seshego circuit, a qualitative study allowed us to gather in-depth information to analyse how mobile technologies affect the process of teaching and learning. The researcher created meaning using the experiences of the respondents, such as in the studies conducted by Pholoto and Mtshweni (2016), Chigona, Chigona, Kayongo and Kausa (2010) and Beyers and Hlala (2015).

This study benefits from adopting a qualitative research strategy. Qualitative studies provide explanations of how people view and experience a certain research issue, and also assist us in understanding complex societal issues (Mack, Woodsong, Macqueen, Guest and Namey, 2005). A qualitative research strategy offers researchers a flexible research environment within which to explore one specific research issue until they understand and know the meanings that participants attach to that specific research issue. The researcher requires this strategy to comprehensively interrogate mobile technology integration into the process of teaching and learning, as it supports methods of data collection and analysis that facilitate an understanding of how and why interventions are implemented in certain contexts. This strategy is flexible and allows the research participants to be more elaborate and give more detail, while giving the researcher an opportunity to probe and tailor subsequent questions in response to the participant's answers (Mack, Woodsong, Macqueen, Guest and Namey, 2005). Participants answer in their own words and are not forced to choose from a list of answers.

3.2 Research design

A research design is a plan to collect data that will assist the researchers in answering the research questions. This plan includes how data will be collected, processed and analysed (Bryman, 2012, Leavy, 2017 and Taylor, Bogdan and DeVault, 2016). The data collection plan addresses the following: (i) procedures that will be used for data collection for

example observations or interviews; (ii) the sample size and identification of research participants that would be part of the study; and (iii) data collection, analysis, and interpretation procedures (Taylor, Bogdan and DeVault, 2016, Nayak and Singh, 2015 and Bryman, 2012).

Bryman (2012) identifies five research designs, namely, cross-sectional, longitudinal, case study, comparative, and experimental design. This study employs the case study research design. A case study is an in-depth investigation of one person, group, event, context or community (Nayak and Singh, 2015). Case studies can be used in many fields, such as in evaluation, where a researcher wants to develop an in-depth analysis of a case (Cresswell and Cresswell, 2018). A case study is associated with a particular space and time (Bryman, 2012 and Cresswell and Cresswell, 2018). Researchers spend a considerable amount of time collecting data to understand the social, cultural and political factors associated with the phenomenon of interest (Bryman, 2012, Nayak and Singh, 2015 and Cresswell and Cresswell, 2018). This study decided on a case study because it is an in-depth investigation of a problem in its real-life setting, and the researchers wanted to understand the problem from social, cultural, economic and political perspectives (Cresswell and Cresswell, 2018 and Nayak and Singh, 2015).

Chigona, Chigona, Kayongo and Kausa (2010) conducted an empirical survey on domestication of ICT in schools in disadvantaged communities in South Africa. The study aimed to investigate the factors that affect the integration of ICTs in teaching and learning. The researchers carried out a qualitative research study with a case study design in order to understand people and the social and cultural contexts within which they live—especially in schools in disadvantaged communities in South Africa. This case allowed them to understand the domestication of ICTs in rural schools of South Africa. People are more relaxed when in their own environment; therefore, they would contribute meaningfully to the research process.

Vandeyar (2015) carried out an assessment of how well district and province's e-learning officials are equipped for the task of implementing the national e-Education policy. The researcher aimed to understand how the district and province's e-learning officials prepared to implement the e-Education policy, the type of training they received before the implementation of the e-Education policy, and what steps they followed to ensure the policy is implemented at school level. A case study allowed the researcher to have an in-depth assessment of the experiences of the officials in the implementation of the e-

Education policy and understand their experiences from their natural habitat in schools where they intended to implement the policy.

Following the assessment from Vandeyar (2015), Pholoto and Mtsweni (2016) carried out a study in under-resourced schools of the Greater Tubatse Municipality (see Section 2.3). The study aimed to investigate the state of, and challenges related to, ICT infrastructure and to determine the nature of educational content and services required. The research design was chosen because it gives information about people's real experiences about a certain phenomenon, as well as how people understand and experience their surroundings. As this research design allows for an in-depth investigation of a problem, this study will be able to understand and explain how the participants make sense of their experiences and how they experience mobile technology integration into schools. During case study information gathering, new ideas might emerge that contribute to the development of new knowledge in the field of ICT in Education.

Based on the above studies by Chigona et al. (2010), Pholoto and Mtsweni (2016) as well as Vandeyar (2015), this current study adopted the case study research design, for its various potential benefits. Specifically, the researcher wanted to benefit from the spontaneous contributions that may emerge when people participate from within their own contexts, and from the emergence of new ideas that would contribute to ICT in Education. It would allow us to understand and analyse the experiences of the teachers with the ICT4E initiative, as well as their use of mobile technologies in the teaching and learning process.

This research design gives a researcher an opportunity to focus on one specific case in order to deeply understand it from the perspective and experiences of the participants (Gable, 1994 and Mack et. al., 2005). A case study design allows the researcher to ask penetrating questions in order to understand the nature and complexity of a research issue (Gable, 1994 and Mack et. al., 2005). New topics and theories can emerge as the researcher engages with participants, which contributes to the development of knowledge (Gable, 1994 and Mack et. al., 2005).

3.3 Research procedure and methods

This section documents the actual procedure and the methods employed in this research to collect, process and analyse empirical evidence. The researcher details the data and information collection instruments (Section 3.3.1), the target population and sampling of

respondents (Section 3.3.2), the ethical considerations associated with the research process (Section 3.3.3), data and information collection process and storage (Section 3.3.4), data and information processing and analysis (Section 3.3.5) and a description of the background of respondents who provided empirical evidence for this research study (Section 3.3.6).

3.3.1 Research data and information collection instrument(s)

A research data collection instrument is a tool used to collect information from research respondents (Nayak and Singh, 2015 and Bryman, 2012). It contains a set of questions that would elicit an in-depth discussion of the experiences and reality of the research participants (Taylor, Bogdan and DeVault, 2016 and Cresswell and Cresswell, 2018). Data can be collected in two ways, namely, as numbers or as words (Cresswell and Cresswell, 2018). Nayak and Singh (2015) differentiate between two examples of data collection instruments: a schedule and a questionnaire. A "Schedule is the name usually applied to a set of questions which are asked and filled in by an interviewer in a face-to-face situation with another person" (Nayak and Singh, 2015, p. 61). This means a schedule is utilised when a researcher interacts with the respondents through observation and face-to-face conversations. A questionnaire, on the other hand, is a tool that is prepared for the respondents to fill in on their own, so as elicit get responses that would answer the research questions (Nayak and Sign, 2015 and Cresswell and Cresswell, 2018).

Bryman (2012), Cresswell and Cresswell (2018) and Taylor, Bogdan and DeVault (2016) identify two main instruments for qualitative data collection, namely, an observation schedule and an interview schedule. This study utilised a semi-structured interview schedule to gather data and information from research participants. A semi-structured interview schedule is a tool that consists of questions that would elicit responses from participants in a consistent manner. (Nayak and Singh, 2015 and Leavy, 2017). In addition, a questionnaire was sent out to the participants who were unavailable for telephonic interviews.

3.3.1.1 Research data collection instrument: structure

A data collection interview can adopt three structures, namely, unstructured, semi-structured and fully structured (Bryman, 2012). Nayak and Singh (2015) also add open versus ended, ranking versus rating and single versus multiple responses questionnaires. For qualitative research, an interview or observation guide is "flexible and open to change as the research proceeds" (Taylor, Bogdan and DeVault, 2016, p.40). However, due to the

changing nature of research contexts, a qualitative research data collection instrument can be structured, especially if it is administered via the internet, email, or post.

This study used document analysis as well as semi-structured interview schedules to collect data and information. Document analysis is a secondary data collection process, whereby a researcher uses research reports and memos collected by other researchers in the same project.

In 2016, Pholotho and Mtsweni, in their quest to understand the state of ICT infrastructure in schools, determined what educational content and services the schools need, and documented the ICT infrastructure challenges faced by the schools. They used a combination of questionnaires, semi-structured interviews, document analysis and direct observations to collect data, and combined the procedures in order to triangulate the information that they were gathering.

Vandeyar (2015), in their assessment of how well the district and province's e-learning officials were equipped for the task of implementing the national e-Education policy (see Section 3.2), used a combination of data collection techniques to gather information (e.g., semi-structured interviews and document analysis). This provided the researcher with a full picture of what the teachers' experiences are as well as how it has been documented. The methods used allow for data triangulation, therefore rendering the data collected reliable and valid.

This study benefitted from using a combination of data collection techniques, because the various methods ensure that the data collected is valid and reliable. These techniques also allow for data triangulation, therefore increasing the data reliability and validity.

For this study, interviews were conducted over the phone with some teachers. The researcher could not secure any video interviews as the teachers complained of data costs. This presented a limitation, because body language and facial expressions offer great insights into understanding how people react to some questions and how they process, understand and answer questions.

By conducting interviews, the researcher was able to capture the meanings that teachers attach to the use and integration of mobile technologies in the process of teaching and learning, as well as gain understanding of their attitudes towards technology use in education. The documents analysed offered us the opportunity to assess whether the ICT4E initiative had achieved some of its intended outcomes and was implemented as per the project plan.

Due to the limited availability of some teachers, the researcher also collected data using surveys. The teachers were attending workshops and planning lessons in preparation for the schools opening. The researcher obtained consent from the teachers to call them in cases where the researcher needed more clarity; since they were not available for a full 45-minute interview but could fill in the surveys and return them back to the researcher and were willing to clarify any issues that the researcher encountered with their responses.

3.3.1.2 Research instrument: sources of questions.

The instrument included seven sections. Section A comprised educators' biographical information, Section B explored teachers' exposure to mobile technologies prior to the ICT4E initiative, Section C interrogated teachers' uses of technology, Section D explored perceived self-confidence with integrating technologies in teaching and learning, Section E investigated the school climate and support, Section F addressed improved school practice and sustainability and Section G explored ICT literacy and technology acceptance.

Section A gathered information on the teachers' biographical information, such as age, gender, experience, academic qualifications and subjects in the school, and determined if they were part of school management teams.

Section B contained the ICT exposure that the teachers had before the initiative. This assisted us in determining whether the outcomes the researcher observed were indeed results of the initiative, or the results of teachers' prior exposure to ICTs.

Section C covered the uses of ICT in schools by teachers; this enabled us to understand if teachers integrated mobile technologies in teaching and learning, or whether they were still using the chalk and duster method.

In Chapter 2 of this report, the researcher discovered that one of the reasons why teachers do not integrate technologies in teaching and learning is that they are not competent and confident to use the technologies. Section D assisted us in gauging how confident the teachers were in their use of technology for teaching and learning.

The literature review in Chapter 2 also led us to discover that technology use and integration into schools fail if not supported by the school management team; therefore, in Section E the researcher sought to establish the support that teachers had from the school management.

In Section F, the researcher wanted to determine the outcomes of mobile technology integration into schools, as well as the sustainability of the new norm of using mobile technologies for teaching and learning.

In the final Section G, the researcher explored whether the people have accepted the use of the available technology hardware and software.

The questions from the various sections are a combination of the researchers own developed research questions, as well as an adaptation of the ICT4E initiative questionnaires that were used during various stages of the project.

3.3.2 Research target population and selection of respondents

3.3.2.1 Research target population

A target population is defined as "the set of all individuals, items, or data of interest" (Leavy, 2017, p. 76 and Nayak and Singh, 246). Bryman (2012) defines a target population as group of elements from which a sample is drawn. A target population is defined by clear objectives of the research and the types of data that can be collected to respond to research questions (Taylor, Bogdan and DeVault, 2016).

The target population of this study is 25 teachers in the Limpopo cluster of the ICT4E initiative. These are teachers from three under-privileged and under-resourced schools in the Seshego circuit of the Capricorn district. The teachers took part in training that was provided as part of the ICT4E initiative. The training included how to use various strategies to integrate mobile technology into teaching and learning and was accredited by the University of the Free State as part of the initiative's goal of continuous training of teachers to improve their skills.

Chigona, Chigona, Kayongo and Kausa (2010) investigated the factors that affect the integration of ICTs into teaching and learning in underprivileged communities of the Western Cape (see Section 2.3). Research subjects were drawn from schools that are under the Khanya project and are located in the disadvantaged areas. The selected participants had first-hand experience of the Khanya project and would be knowledgeable and informed about how it has affected teaching and learning in schools.

As indicated before, the 2016 study by Pholoto and Mtshweni in under-resourced schools of the Greater Tubatse Municipality in Limpopo investigated and documented the state of access to ICT infrastructure and determined the educational content and service needs (see Section 2.3.) This target population of the Greater Tubatse Municipality was selected

because it is in a mountainous area of Limpopo, where services are usually delayed or never received. It provided a good environment within which to understand the problem of electronic technology infrastructure for resource-constrained schools. The population allowed the researchers to understand issues of service delivery in terms of electronic infrastructure in schools.

In the case of the study by Beyers and Hlala (2015) of how e-learning can change the face of education in the Nokotlou, Lebowakgomo and Polokwane circuits of the Capricorn district of the Department of Education, the target population provided an in-depth understanding of the problem from the representative schools.

This study is an evaluation of an ICT4E intervention that has been in progress for some time in the three schools and provided an environment in which to gather meaningful contributions from teachers who were part of the ICT4E initiative and had been trained by the University of the Free State.

3.3.2.2 Sampling or selecting respondents from the target population

Sampling is selecting a group from which to collect information and data; it represents the process through which a sample is selected from the target population (Leavy, 2017 and Cresswell and Cresswell, 2018). A sample is a small group of people from which data is collected, analysed and interpreted in order to make generalisations about the broader population (Bryman, 2012 and Leavy, 2017). A number of sampling methods can be adopted in qualitative research, namely, purposive sampling, convenience sampling, snowballing and quota sampling (Bryman, 2012 and Nayak and Singh, 2015). Two categories of the sampling method exist, namely, probability sampling and non-probability sampling (Nayak and Singh, 2015 and Bryman, 2012). Probability sampling is sometimes called random sampling and non-probability sampling is sometimes called non-random sampling (Nayak and Singh, 2015).

This study used purposive sampling. Purposive sampling is non-probability, non-random sampling (Bryman, 2012, Cresswell and Cresswell, 2018 and Nayak and Singh, 2015). The sampling technique does not allow the results of the research to be generalised to the population (Bryman, 2012). Purposive sampling puts the research questions at the heart of the sampling considerations (Bryman, 2012). The goal of purposive sampling is to ensure that the research participants are able to answer the research questions (Bryman, 2012).

Purposive sampling was selected for this study because it is time and cost effective, and researchers are able to obtain a lot of information from the data that they collected (Cresswell and Cresswell, 2018 and Nayak and Singh, 2015). Purposive sampling would allow us to describe the impact of the findings on the population (Taylor, Bogdan and DeVault, 2016). The researcher used this type of sampling because they wanted to target the participants that would be able to answer the research questions, because they were part of the initiative since its inception. These teachers were purposefully selected because they had been trained to use mobile technologies in the classroom, and therefore had first-hand experience of how they used the knowledge from training to integrate mobile technologies.

In Pholotho and Mtsweni's (2016) qualitative study (see Section 2.3), research participants were purposively selected. The selected participants were more knowledgeable and informative about their real life setting and understood the challenges that they experienced when it comes to ICT provision in their schools.

In Vandeyar's 2015 study on policy intermediaries and the reform of e-Education in South Africa (see Section 3.2), purposive sampling was used since it offered culturally diverse respondents who were knowledgeable about their context and would contribute meaningfully to resolving the research problem.

This study selected a purposive sampling technique because it is time and cost effective. Data were collected from diverse socio-cultural respondents who would provide insightful information from their own personal experiences influenced by the context through which they used mobile technologies. The researcher called all teachers and set up appointments for interviews; however, the set times usually either clashed with teacher workshops and staff meetings and were not always honoured. In the end, the researcher was able to interview 3 teachers and send out 25 surveys, of which 8 completed surveys were returned. This means there were 11 participants for this study across the three schools.

3.3.3 Ethical considerations when collecting research data

Ethics involve morality, integrity, fairness, and truthfulness; it is about knowing what is right and wrong (Leavy, 2017 and Cresswell and Cresswell, 2018). Researchers have the responsibility to make sure that participants are protected during the data collection process, in addition build a good rapport with participants to improve research integrity

and eliminate inappropriate conduct (Taylor, Bogdan and DeVault, 2016 and Nayak and Singh, 2015). Ethics in research protect both the participants and researchers in the research process. There are four main ethical considerations in social research, namely, no harm to participants, consent from participants, privacy and confidentiality of research participants and no deception for participants (Bryman, 2012 and Nayak and Singh, 2015).

The author of this work is a Masters student, with an academic interest in this research, that will yield no financial benefit. Hence, the researcher followed the ethical considerations from Bryman (2012) and Nayak and Singh (2015), as well as those outlined in the Wits School of Governance ethical guidelines.

3.3.3.1 Ethical consideration: Informed consent

All research participants should agree to participate in the research study (Nayak and Singh, 2015 and Bryman, 2012). Respondents should be informed that they can refuse to answer some of the questions that they do not feel comfortable answering (Nayak and Sing, 2015). Participants should give consent in the form of a signed consent form to show that they are voluntarily part of the study (Nayak and Singh, 2015 and Cresswell and Cresswell, 2018). A researcher has to seek respondents' consent before engaging with them during the research process.

Teachers were called telephonically to set-up appointments for the interviews; the purpose of the study was explained to them and they gave consent to participate in the study. However, most of them could not honour the interview times as they were usually in workshops and staff meetings to prepare for the 2021 school year; they preferred to receive a copy of the questionnaire on which to answer the questions before returning them to the researcher. The researcher delivered the questionnaires to the schools and gave teachers some time to fill in the questionnaire; then provided them with our contact details, in case they needed clarity on any of the questions. Some teachers were not reachable via cell phones and delivering the questions at the schools assisted in reaching these teachers. The teachers have given us permission to call them, should the researcher need clarity on any of their responses.

Telephonic interviews would have been time consuming, and the use of delivered questionnaires enabled them to fill them in at their convenience. All consent forms were signed, and an information sheet was left with the principal in case they would like to know more about the research.

3.3.3.2 Ethical consideration: Privacy

Researchers have to protect the privacy of respondents' personal information by not keeping it on hard drives; for safe keeping, they can use codes and identifiers that they can understand (Bryman, 2012 and Taylor, Bogdan and DeVault, 2016). Data that is collected has to be kept in a file that is password-protected to control access. The completed questionnaires were kept in a locked cupboard for a period of five years, while the captured data were kept in the Cloud in a password-locked file. None of the teachers or schools would be directly mentioned in the research findings to protect their identities.

3.3.4 Research data and information collection process

Research data collection is a process of gathering the data that would assist in answering the research questions (Bryman, 2012). In qualitative research, data collection can be in various ways, such as participant observation, in-depth interviewing, focus group discussions, visual material and content analysis (Taylor, Bogdan and DeVault, 2016 and Bryman, 2012). Qualitative researchers do not rely on one way of collecting information, but use combinations of interviews, observations, documents, and audio-visual information (Creswell and Creswell, 2018). The data collection process in qualitative research is characterised by "open-ended forms of data in which the participants share their ideas freely, not constrained by predetermined scales or instruments" (Creswell and Creswell, 2018). Bryman, 2012 and Cresswell and Cresswell mention the four modes of data collection as participant observation or ethnography, interviews (face-to-face, telephone, or internet-based), focus group discussion and documents.

The ICT4E monitoring and evaluation team conducted monitoring regularly and provided quarterly reports on how the project was progressing; the researcher reviewed those reports to triangulate our results. The data collected from the research participants were recorded via audio recording, transcribed, cleaned and then analysed. In addition, the researcher would have done observations in the classrooms to see how teachers and learners use the technologies in the teaching and learning process. However, due to the COVID-19 pandemic, this was no longer possible. The raw research data are kept in a locked cupboard, while the typed data are protected via password and stored in the Cloud.

This study collected data through document analysis, semi-structured interviews and questionnaires. Document analysis entails an evaluation of printed and electronic material to gain knowledge and understand the subject matter (Bowen, 2009 and Bryman, 2012). Documents may include "advertisements; agendas, attendance registers, and minutes of

meetings; manuals; background papers; books and brochures; diaries and journals; event programs (i.e., printed outlines); letters and memoranda; maps and charts; newspapers (clippings/articles); press releases; program proposals, application forms, and summaries; radio and television program scripts; organisational or institutional reports; survey data; and various public records" (Bowen, 2009, p. 28). Document analysis is combined with other methods of data collection in order to triangulate the claims made by the researcher (Bowen, 2009). The researcher relies on data that was collected by others (Bryman, 2012 and Bowen, 2009).

A structured questionnaire was distributed at schools, for the participants to answer the posed research questions.

This study has chosen these data collection techniques because it would allow triangulation of the findings from the research and increase the credibility of the findings, as they do not come from one source of information.

Previous studies like this research have utilised document analysis, semi-structured interviews, observations and other forms of data collection. For example, Chigona, Chigona, Kayongo and Kausa (2010) carried out a study on domestication of ICT in schools in disadvantaged communities in South Africa, to determine the factors that affect the integration of ICTs in teaching and learning (see Section 2.3). The researchers selected semi-structured interviews for data collection since it provides researchers an opportunity to ask clarity questions when there is a need and respondents are able to open up about their experiences.

The second study that utilised both the document analysis and semi-structured interviews as forms of data collection is the study on barriers to Electronic Access and Delivery of Educational Information in Resource Constrained Public Schools: A Case of Greater Tubatse Municipality, which focused on access to infrastructure (see Section 2.3) The researchers collected data through semi-structured interviews, direct observation, questionnaires and literature review. The researchers collected data through semi-structured interviews, direct observation and literature review. Interviews allows the researcher to capture both verbal and non-verbal cues. The researcher has control of the interview and can keep participants focused. Observations allows for participants observation in theory natural habitat.

The third study utilised document analysis and other forms of data collection. This is a study by Vandeyar, completed in 2015. This study is an assessment of how well the

districts' and province's e-learning officials were equipped for the task of implementing the national e-Education policy. Interviews, observations, field notes and document analysis were used to gather data. This provided the researcher with a full picture of the teachers' experiences, as well as how it has been documented. The use of different data sources assisted with data triangulation and credibility of the data collected.

These data collection techniques were beneficial to the current study, because they assisted with triangulation and data credibility. The interviews assisted in answering follow-up questions in instances where clarity was needed.

The raw data collected for this study is kept safe and confidential. The completed instruments is kept in a locked cupboard, and the captured data is saved in the Cloud with a password to control access to the information.

3.3.5 Research data and information processing and analysis

1. Research data and information processing

In qualitative research, processing is about coding the data, identifying the themes to prepare it for analysis (Taylor, Bogdan and DeVault, 2016 and Nayak and Singh, 2015), and making sense of the collected data and preparing it for analysis (Cresswell and Creswell, 2018). Some people use data analysis software to process the data and obtain a preliminary analysis for further interpretation.

Qualitative and quantitative research strategies process data in different ways. Qualitative researchers process information through transcribing, determining the themes and data fragmentation. The first step of qualitative data processing is transcribing. This is the process of reproducing written words from the audio-recorded interviews word-for-word (Bryman, 2012 and Cresswell and Cresswell, 2018). In this study, the reseacher delivered questionnaires at schools for teachers to complete them at their own chosen time, as the researcher could not secure full telephonic interviews due to their busy schedule. The data collected from the questionnaires were captured and collated to prepare for data analysis.

Determining themes, either theoretically or data-driven, is the process by which themes are identified in the collected data (Bryman, 2012, Leavy, 2017 and Cresswell and Cresswell, 2018). "Qualitative researchers build patterns, categories, and themes from the bottom up by organizing the data into increasingly more abstract units of information" (Cresswell and Cresswell, 2018, p301). In their study, Pholoto and Mtsweni (2016)

identified patterns and themes from the data that they collected during their study in the Greater Tubatse municipality.

For this study, the data were captured in Microsoft Excel, and were organised along the posed research questions. The researchers identified themes from the data, and through literature that were reviewed as the study progressed. Example of the emerging themes include technology integration, technology use, school management support, safety and security in schools, community of practice, implementation, and mobile technology. Initially, three research questions were explored; as the researchers captured the data and started identifying themes, two more research questions were added as some new themes emerged.

2. Research data and information analysis

Data analysis is the process of incorporating different elements from the processed data to create new insights about a context under study (Bryman, 2012 and Cresswell and Cresswell, 2018). This process involves making decision on which information is important and have to be kept, and which information to discard (Nayak and Singh, 20115). Data analysis is a "mechanical or technical process; it is a process of inductive reasoning, thinking, and theorizing." (Taylor, Bogdan and DeVault, 2016, p168). Qualitative data can be analysed in various ways, namely, content analysis, narrative analysis, discourse analysis and grounded theory (Cresswell and Cresswell, 2018, Leavy, 2017 and Bryman, 2012).

This study undertook thematic content analysis of the collected data. Thematic content analysis is a qualitative data analysis method, which usually applies to texts such as interview transcripts. The researcher identifies common ideas, themes, and patterns from the data (Leavy, 2017 and Cresswell and Cresswell, 2018). There are two approaches to thematic analysis, namely, an inductive and a deductive approach (Leavy, 2017 and Taylor, Bogdan and DeVault, 2016). An inductive approach is when a researcher is led by the data to obtain themes, while the deductive approach is when a researcher already has identified themes from elsewhere and apply them to their study (Leavy, 2017 and Taylor, Bogdan and DeVault, 2016). This study will employ thematic content analysis, because it provides a rich description of the experiences of the research participants and their contexts.

A study that utilised thematic content analysis is the study on barriers to Electronic Access and Delivery of Educational Information in Resource-Constrained Public Schools: A

Case of Greater Tubatse Municipality, by Pholoto and Mtsweni (2016). Thematic data analysis was adopted because it offered the researchers the ability to see emerging themes without having to set up technological tools or run codes that would recognise emerging themes. Analysis can be initiated without involving other people to assist with running codes or setting up analysis tools.

3.3.6 Description of the research respondents

The research respondents in this study are teachers employed in the selected schools in the Seshego circuit. These are teachers who took part in the training provided as part of the ICT4E initiative that has been running in the schools over the four years preceding this study. The researcher delivered 10 questionnaires per school, and received 8 completed questionnaires from all three schools; 3 interviews were conducted telephonically. To protect the identity of the participants, the demographics are grouped per category.

In terms of gender, more females responding than males responded, as depicted in Figure 3.1.

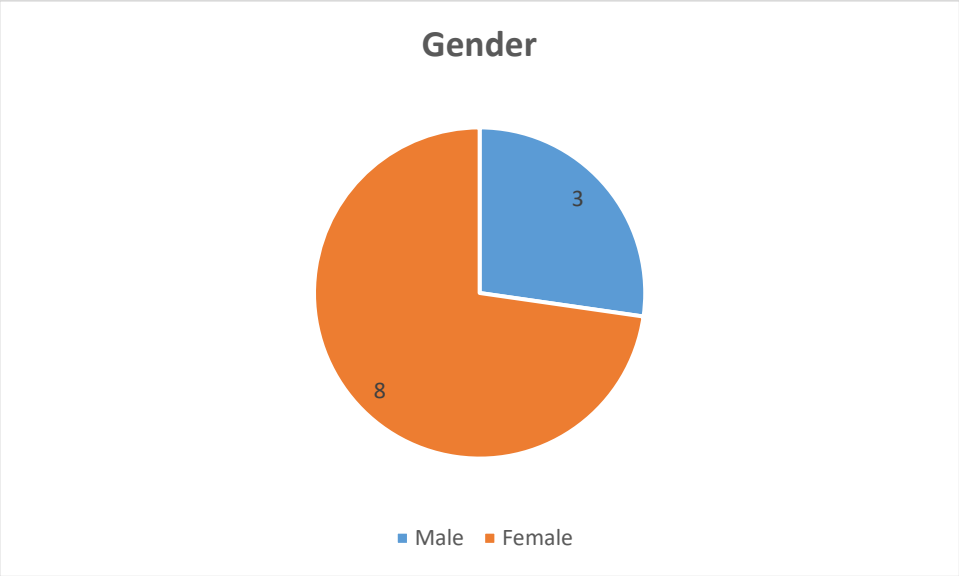

Figure: 3.1. Gender of respondents (Source: author)

In terms of age most of the respondents were between the ages of 50 and 60, with one person being between 30 and 40, while one person was 60+, as depicted in Figure 3.2.

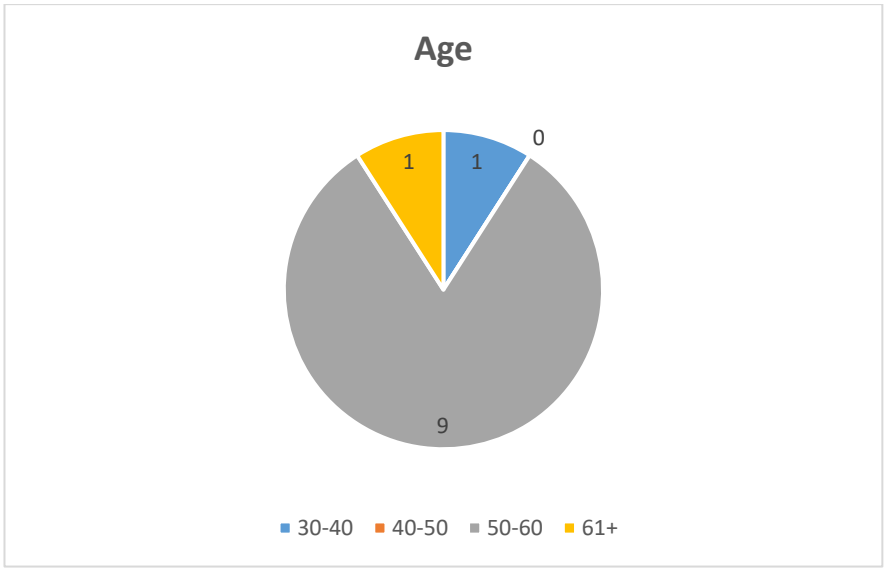

Figure: 3.2. Age of respondents (Source: author)

The level of qualifications of the majority of the teachers (7 out of 11) is an Honours degree in education, as depicted in Figure 3.3.

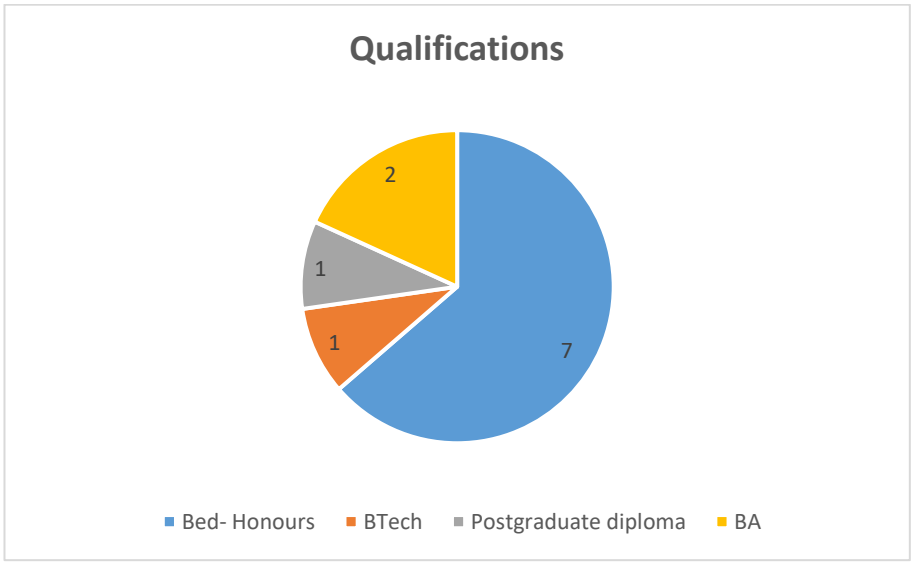

Figure: 3.3. Qualifications of respondents (Source: author)

3.4 Research strengths: reliability and validity measures applied

In the 1950s and 1960s, researchers stopped measuring qualitative methodologies using quantitative standards because "Proof is illusive in qualitative research" (Taylor, Bogdan and DeVault, 2016, p189). However, this does not mean that qualitative research should not be subjected to quality standards. Researchers can use thoroughness and congruence to evaluate qualitative studies to ensure that they are of good standard (Cresswell and Cresswell, 2018).

Generally, reliability is concerned with repeatability of results, that is, can the instruments of research produce consistent results (Bryman, 2012, Leavy, 2017, Creswell and Creswell, 2018 and Nayak and Singh, 2015). Validity is the accuracy of a method in terms of measuring what it intended to measure (Bryman, 2012, Leavy, 2017, Creswell and Creswell, 2018 and Nayak and Singh, 2015). In qualitative research, authors speak of credibility and trustworthiness to measure the quality of the research (Creswell and Creswell, 2018). Reliability speaks about how consistent a measure is in a study. Reliability refers to the consistency of results (Leavy, 2017 and Bryman, 2012).

Qualitative and quantitative researchers use slightly different criterion for quality checks. Quantitative researchers uses reliability and validity while qualitative researcher use credibility, neutrality or confirmability, consistency or dependability and applicability or transferability (Golafshani, 2003). Cresswell and Cresswell (2018) use thoroughness and congruency as the quality measures of qualitative research. Thoroughness refers to how extensive sampling, data collection are, while congruence refers to how the research questios, methods, procedures, findings fit together (Cresswell and Cresswell, 2018). "To be more specific with respect to the term of reliability in qualitative research, researchers use "dependability", which closely corresponds to the notion of "reliability" in quantitative research" (Golafshani, 2003, p601).

Chigona, Chigona, Kayongo and Kausa (2010), in their study into the factors that affect the integration of ICTs in teaching and learning, have used qualitative measures to ensure that their study complies with the quality criterion of qualitative research. In order to establish credibility the participants were asked to review the trascripts to verify that the data captures their responses accurately. The researchers also observed classrooms during teaching and learning to see how the integration process takes place, to verify the data that they collected from the research respondents.

Pholoto and Mtshweni (2016) also ensured the reliability and validity of their study by using various methods of data collection in order to triangulate the information and establish consistency amongst the information from the research participants.

In this study data was collected through telephonic interviews and questionnaires, and analysed documents of the intervention. In addition, the researcher have followed up telephonically with four teachers to clarify some of the responses that the researcher did not understand.

3.5 Research weaknesses: technical and administrative limitations

Technical limitations in research can start from the outset of a study, when a researcher formulates the aims or objectives of the research and choosing a difficult research design and research methods (Rahman, 2017). Qualitative research methodologies rely on the experience of the researcher and are not statistically represented from the data collection perspective (Rahman, 2017 and Leavy, 2017). Hence, a first limitation in this study is that the researcher's experience and position might have influenced how data was collected, related to participants and reported on (Leavy, 2017). The findings might not be generalisable to the population, or replicable in other contexts (Rahman, 2017).

In this research, a second limitation was constraints with teachers' availability; the researcher had difficulty with teachers honouring scheduled interview times, as they were preparing for the schools' opening by attending workshops and staff sessions. This led to the decision to rather distribute questionnaires to all schools and have all available teachers respond, then the researcher sought clarity during data capturing

Third, since purposive sampling was employed, the views of the participants might not represent the views of the entire population. This research took place during the COVID-19 pandemic, which prevented the researcher from visiting schools to observe participants using the technologies during teaching and learning. Due to the pandemic, the researcher was also unable to include teachers who have not been trained as research participants, to get their views on how technologies were integrated in teaching and learning. To make sure that the researcher triangulates and corroborate data, the researcher used various methods of data collection to improve data validity and reliability.

Fourth, document analysis as a method of data collection has some limitations, because it does not include data that is not documented; instead, it is in the minds of the original data collectors as well as various stakeholders of the initiative. With the interviews, participants might also give information that they think the researcher would like to hear; this aspect had been reduced by using multiple sources of data during collection.

Fifth, data analysis is subjective, and, for novice researchers, it might be hard to select the themes of importance that will answer the posed research questions (Gale, 1994).

This chapter focused on the practical side of carrying out this research. The chapter identified the strategy that will be used in this research. It laid out the foundations for collecting, storing and analysing data, as well as touched on issues of ethics in research. In addition, the chapter informed of who the population and sample of this research are as well as how issues of ethics will be dealt with when engaging with the research participants. The chapter closed off with limitations that the researcher encountered as they practically carried out the research. After the data collection storing and analysis then the following chapter (4) presents what the data has revealed in terms of technology use and integration in teaching and learning.

4 PRESENTATION OF RESEARCH RESULTS

This chapter presents the research results. Four research questions were posed in Chapter one to assess the outcomes of an information and communication technology for education (ICT4E) intervention with a specific focus on teachers. Literature from similar studies was reviewed in Chapter two to find the knowledge gap and to present the conceptual and interpretive frameworks for the study. The literature review assisted in situating this study within the field of ICT. Two attributes, namely, technology hardware and software, have been identified as key to answering the research questions. These attributes assisted us in drafting the research instrument, which is important as it assists in gathering the relevant answers to the research questions posed in Chapter one. With the help of literature from similar studies, we detailed how the research proceeds in Chapter 3: the relevant research strategy, procedures and methods were identified, to be adopted during data collection to answer the research questions.

In this section, the research questions are answered by presenting the empirical research results by outlining the relevant themes that emerged during data capturing, collation and analysis. Thereafter, the research questions are answered through the discussion of the themes and quotes that emanated from the collected data, and summarise by comparing our results to similar studies, as reviewed in Chapter two. This process was followed to ensure that the research have filled the research gap, as well as identified any new information that would contribute to knowledge on mobile technologies in education. This process was undertaken for all four questions, based on the collected data.

4.1 Intended outcomes of the Information and Communications Technology for Education (ICT4E) intervention

In this sub-section, the researcher presents the answers to the first question, namely, "what were the intended outcomes of the ICT4D initiative for the teachers?" Data was obtained for this question from project documents as well as from the research respondents' answers to the research questions. The themes emerging for this question are technology implementation, teacher professional development, teachers' perceived competence and technology adoption. These themes were selected for the question because they would assist in understanding how the intervention was implemented and whether the intended objectives of the intervention were realised, with specific focus on

teachers. Depending on the outcomes, the researcher discusses in Chapter five what the results mean for the beneficiaries and for all the relevant stakeholders in the implementation.

4.1.1 Presentation of the empirical research results - Responses to the research question: What were the intended outcomes of the ICT4D initiative for the teachers?

4.1.1.1 Teacher Professional development, technology adoption and implementation

Besides the provision of technology infrastructure to schools, teacher professional development is also of importance (Mdlongwa, 2012 and Chisango and Lesame, 2017). Teacher professional development (TPD) is defined as regular and continuous improvement of teachers' skills, knowledge and strategies (Clarke and Hollingsworth, 2002; OECD, 2009). Wang and Gu (2014) describe TPD as the improvement of teaching practice through practical knowledge generation. Botha, Herselman, Musgrave and Jaeschke (2018,p. 2) describe TPD as a "supported process to guide the development of relevant teacher knowledge and proficiency to enable classroom practice to portray a 21st century technology enhanced teaching and learning engagement".

Teacher professional development is a complex issue; several components have to be in place before it can be deemed effective.

One educator had this to say:

"*At first the project was hectic because, as an individual, I never had an opportunity to use technology. As time went by, I started developing interest in the use of technology and used it in class for teaching. I have now developed interest in the project and I think my anxiety has decreased when it comes to technologies in teaching and learning.*"

According to the ICT4E monitoring and evaluation report (Herselman, Botha, Dlamini and Maremi (2019) technology implementation success was measured through the consistent participation of teachers in the TPD sessions. The more teachers attended the training, the more they would integrate and use technologies in their classrooms for teaching and learning. The teacher professional development (TPD) training was divided into six separate sessions (11 units in total) of two consecutive days each.

"*The requirement for successful completion of TPD was that teachers needed to be selected by their school principal to attend the training; They had to be registered as a student for this training at the University of the Free State (UFS); They need to attend at least 90% of the classes (one class can be excused due to illness or a funeral); and They will have handed in and completed three reflective entry journals and two assignments.*"

"TPD candidates (the teachers) were expected to do Reflective Journals 1 - 3 to be submitted during Session 2 (Visit 2), Session 4 and after Session 5 but before Session 6 (the 3rd one was not to be marked, but teachers needed to hand it in to be considered competent). The teacher would complete and hand in 2 assignments – and hand them in at Session 3 and Session 5."

"Many teachers, principals and learners expressed their gratitude to have been part of the project, and this is particularly the case in the deep rural areas."

The project consisted of 24 schools which were divided into clusters of 3 per province to facilitate formation of communities of practice amongst teachers and schools. 10 teachers per school were selected by the principal. The 24 chosen schools were clustered in groups of up to three (3) schools within a 5km radius of each other to facilitate engagement and involve at least 10 teachers from each school. The participating teachers were selected by the principal of the schools to receive training on how to use a mobile tablet to support their teaching.

The teacher professional development (TPD) had two objectives:

1. *To position the rural participating teacher for further lifelong learning; and*
2. *To change the classroom practice of the rural participating teachers to reflect an enhanced teaching and learning engagement through pedagogy for the information age.*

The ICT4E project team carried out a baseline assessment before implementing the teacher professional development modules. The table below depicts the percentage of teachers who were exposed to prior technology training; 82% of the teachers had a basic introduction to computers, while 67 % knew how to use word processors such as Microsoft Word and Excel. Only 18% of the teachers had some technical skills and were integrating technologies in the class using the World Wide Web. Less than 10% of the teachers expressed that they were exposed to some form of ICT leadership and management in their schools.

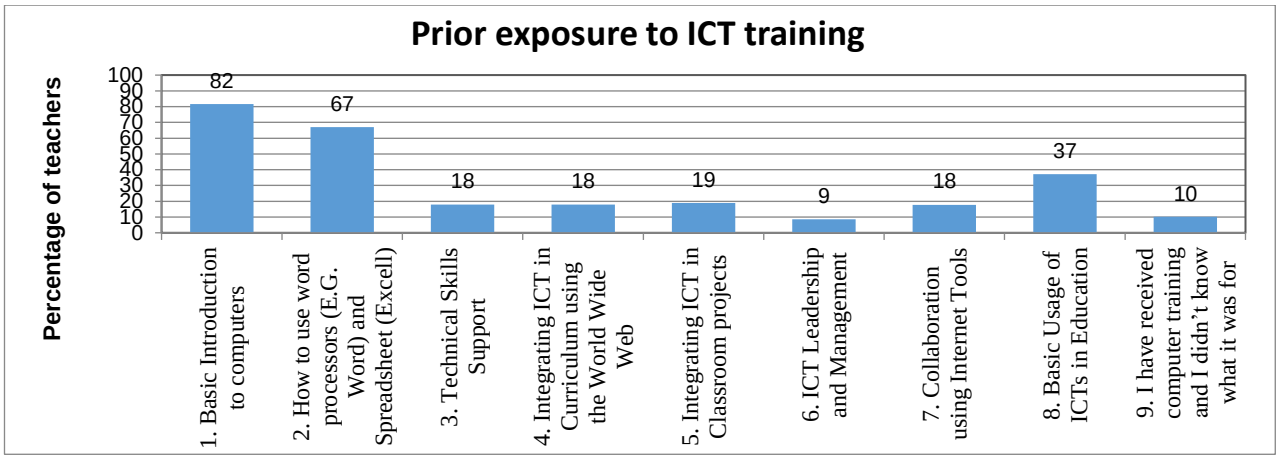

Figure: 4.1. Prior exposure to ICT training (Source: Herselman, Botha, Dlamini, Marais and Maremi, 2019)

After completion of teacher professional development, the picture had changed: more teachers had now been exposed to technology uses in the classrooms and had started using some of the strategies that they had learned during teacher professional development. The table below depicts the percentage of teachers by type of training received.

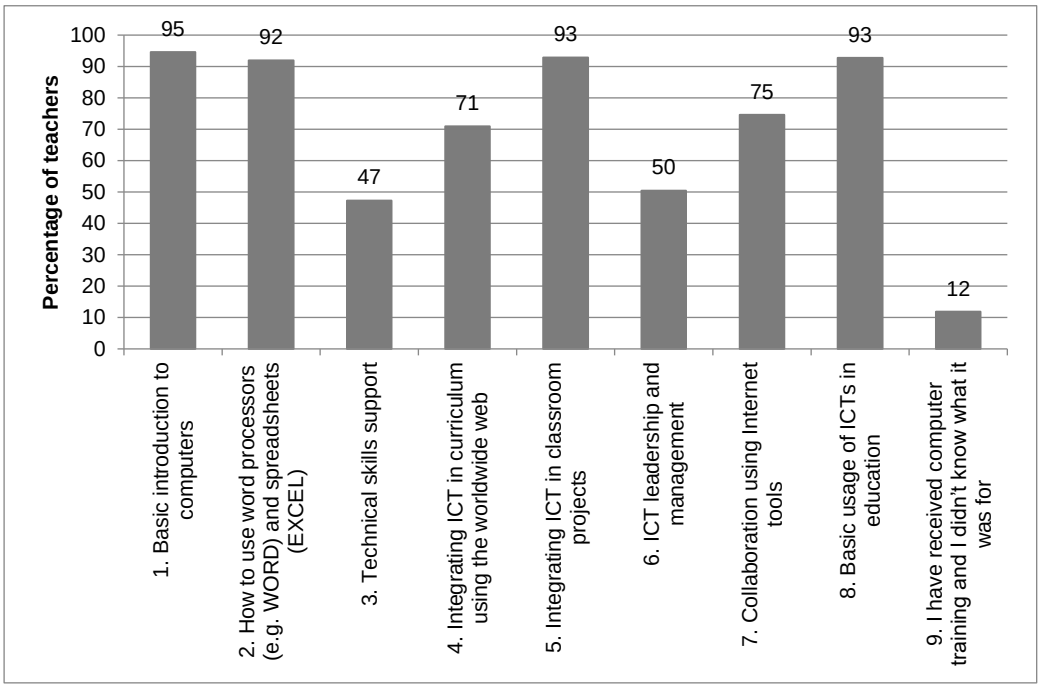

Figure: 4.2. Percentage of teachers by type of training received (Source: Herselman, Botha, Dlamini, Marais and Maremi, 2019)

The project had successfully improved teachers knowledge of ICT through the Teacher Professional Development (TPD). One teacher said:

"I have good ICT skills now after training, I am confident with my search and evaluate skills in regards to obtaining information from the Web."

Another teacher said:

"I think my level of digital literacy is at 70% now. Using ICT will enable me to exercise my teaching work easier and I intend to continue using ICT for my teaching rather than discontinue using it."

This project has effectively fostered collaboration and encouraged the creation of communities of practice. A teacher indicated that there is more collaboration between the schools since the project was implemented in the three schools, this shows that projects of a similar nature should be implemented in schools to encourage and improve collaborations between teachers and schools.:

"ICT enables me to collaborate better with my peers on teaching concepts and learning opportunities, and I think my learners will enjoy using technologies in class because ICT use for teaching is clear and understandable. I will continue using ICT in my classroom."

When it comes to ICT use at the baseline level, teachers reported that they mostly used their cell phones for various ICT needs such as accessing social networking, emailing, taking photos, doing administrative duties such as capturing marks and retrieving lesson plans from the internet. In their responses, 91% of teachers indicated that the school has banned the use of cell phone by learners; the only internet access that they have is from the tablets provided by the ICT4E initiative, and these are used for educational purposes only. The table below shows the results of the ICT use by teachers prior to the TPD implementation.

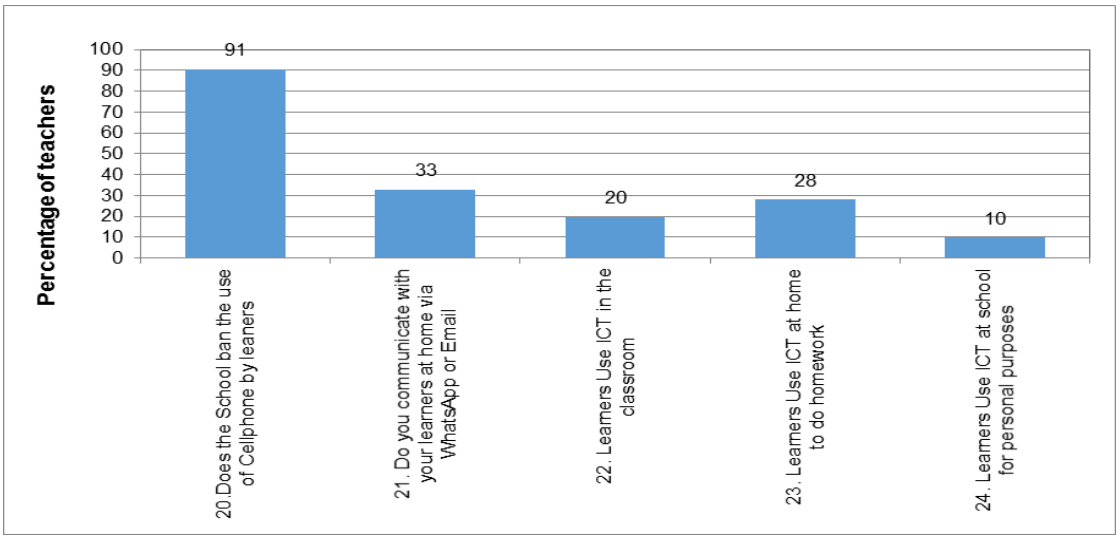

Figure: 4.3. ICT use by teachers prior to TPD implementation (Source: Herselman, Botha, Dlamini, Marais and Maremi, 2019)

After the implementation of the teacher professional development programme, 16% of the teachers were not conducting their personal banking activities through any of the mentioned technology platforms. The majority of the teachers were using their cell phones or tablets for personal applications.

"The majority of the teachers reported that they used their cell phones or tablets to find information on the internet for their classes (78%); reading, watching and listening to content for own professional development (67%); developing digital content (e.g., making a video clip showing an experiment or explaining a concept) (67%); and for using applications in class for teaching (72%). For activities such as: typing examination papers (56%); recording of marks (70%); development of teaching resources (54%); school administration tasks (67%); use of educational videos with a projector for teaching in class (50%); and school email communication (55%), the teachers mainly used a computer at their schools."

The project succeeded in encouraging more teachers to engage in other internet activities besides calling and texting.

A teacher said:

> "*My use of ICT for internet banking, digital content formation (videos) and reading, watching and listening to content for own personal development has improved; I am not confident to search the internet and get specific content that I am looking for my personal development"*

Another teacher reported that their use of internet is no longer limited to a cellphone in this quote:

> *"I use my cell phone, tablets as well as the school computers for various things like educational videos with a projector for teaching in class, school administration tasks as well as developing teaching resources."*

In any development there is always some form of mistrusts of technologies, therefore it is not surprising that one teacher declared that financial matters should not be done on the internet. A teacher reported:

> *"I don't do banking on any of the internet platforms; I prefer speaking to someone face-to-face when it comes to financial matters"*

Following the implementation of TPD, the intended outcomes that should be observed for both teachers and learners are as depicted in Figure 4.1 by the ICT4E monitoring and evaluation planning.

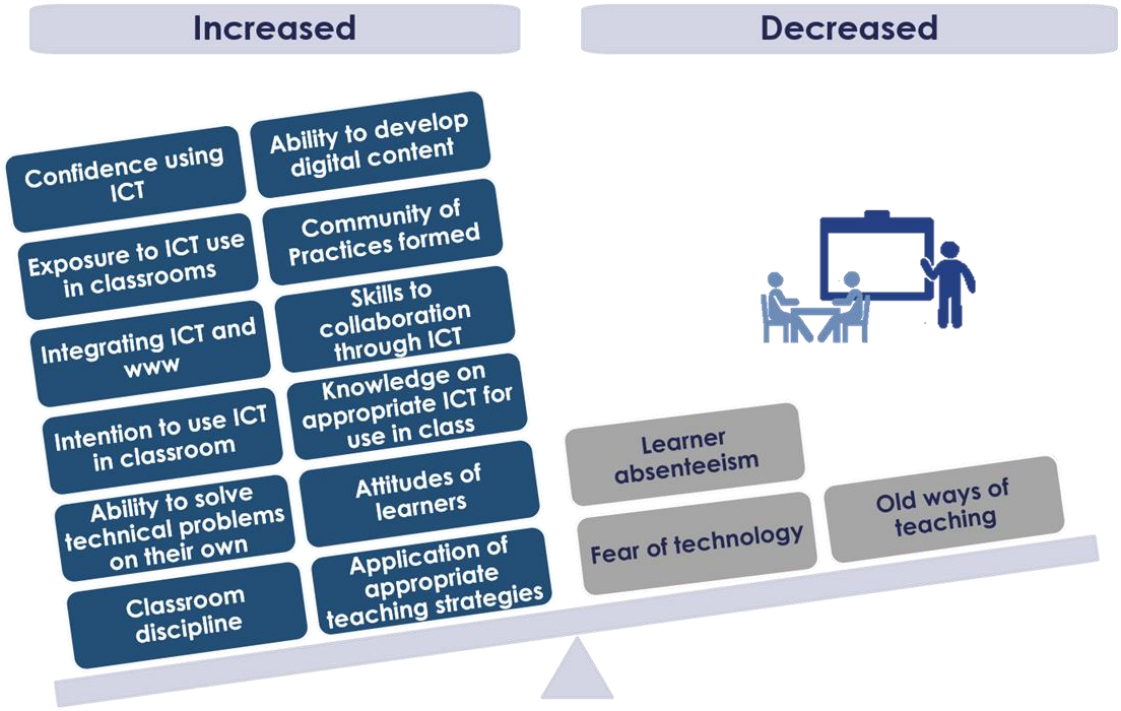

Figure: 4.4. Intended outcomes for teachers and learners (Source: Herselman, Botha, Dlamini, Marais and Maremi, 2019)

The project had succeeded in changing the behaviour, attitude as well as thinking of teachers towards mobile technologies integration for teaching and learning. After the training, teachers had this to say about how technology has changed their outlook on the potential use of technologies in schools:

"This was a very interesting and insightful training; I have learned a lot and now I am computer literate. Thank you so much. ICT are the best for teaching and learning.

It is not surprising that teachers want to encourage the use of mobile technology and integration thereof in classrooms. Another teacher said:

"The type of training we received as teachers as a result of the project is good and should be implemented in all schools of South Africa."

The project has effectively changed the views of the teachers when it comes to technology in the classrooms. Teachers are not confident and are able to integrate and use technologies during their teaching times. This sentiment was shared by more than one teacher. Teacher A responded:

"Educators were empowered to use technology during lessons. They also realised technology is user-friendly if you receive the correct training. The technology helps by reducing the teacher's workload. Technology is great for educators as it assists them with class facilitation. We are now able to use the computers and tablets on our own for teaching and learning without needing assistance from other people."

Another teacher indicated that the project offered them a learning opportunity for interms of ICT use. This is professed in the following quote *"The project offered us a great learning*

opportunity, because all barriers of embracing technology on personal and professional level are no more. I am a champion. It was a shift from 0 to 50%. I can now actively teach learners using tablets. I use lessons that involve graphs and diagrams on the tablets."

Most teachers indicate that this project successfully gave them an opportunity to learn how to use ICT in the class. A teacher responded:

"The project is interesting, we learnt a lot during the teacher training and development sessions. ICT motivated us to be independent and work on our own both as teachers and learners. We got an opportunity to teach using tablets in our classrooms."

Another teacher raised an important issue when it comes to continuous teacher professional development when saying:

"There is an improvement in teaching and learning because of the tablets. However we still need refresher training to continue using technologies for teaching and learning."

Another teacher said that the project has equipped them with knowledge on how to use ICT for teaching and learning in this quote *"Teachers are well equipped, because they have been trained on how to use the tablets. More information is available as we have preloaded content on the tablets and we can use the internet to search for more content. The tablets are easy to use. Both teachers and learners are involved in the process of teaching and learning."*

The researcher then asked teachers if their schools benefitted from the project, and they agreed that schools, learners and teachers all benefitted from the ICT4E project. All teachers agreed that schools, learners and schools have benefitted from the intervention. All teachers who successfully completed training were rewarded with a tablet for both personal and professional use. The teachers also raised the issue of supporting each other beyond the intervention, so that all teachers are taught how to use tablets for teaching and learning. These educators also spoke about getting more tablets for learners, as the tablets are not enough to cater all learners. Some of the teachers also added the fact that they kept the community of practice alive even after the project has ended, because they were able to assist each other in solving some of the technical problems that they had and reminded each other about the strategies that they were taught during formal teacher professional development with the University of the Free State.

Through the following quotes it can be concluded that the project successfully achieved the intended outcomes of the ICT4E project when it comes to teachers:

There is more learning about the use of ICT in teaching and learning:

"Yes, more educators learnt how to use mobile tablets. Those who have received training helped others, so it has benefited the school positively, but we need more devices to have a bigger reach in the school; the tablets provided were not enough."

The interactions between teachers have improved a as result of being part of this project. Teachers now feel more confident as they can assist other educators to use ICT in teaching and learning.

"The personal relations and attribution between learners have improved in class. Located in a rural area, I think the school has benefited because we could not afford all the devices. In addition to the tablets that we received during the project; I think we still need more tablets so that we can have at least 2 learners per tablets. Currently we have more than three learners using one tablet."

Teachers even received certificates from University of Free State to prove that the project has successfully trained them and achieved its objective of ensuring that teachers are trained professionally, their ICT skills and knowledge improve and they become more confident in their use and integration of ICT in teaching and learning.

"*Teachers were trained and received certificates, and they continued to train other teachers that were not part of the project on how to use and integrate technology. We were able to help each other as schools that participated in the intervention. After school we would meet to communicate challenges that we encountered during the day when we used tablets for teaching and learning. We had a WhatsApp group where we also shared the challenges and success of teaching with technology."*

4.1.1.2 Teacher's perceived ICT competence

Teachers' perceptions and attitudes towards technology play an important role when it comes to technology use and integration into the process of teaching and learning. Some teachers believe that technology is a distraction, while others believe that technology would improve the process of teaching and learning. Hermans, Tondeur, van Braak and Valcke (2008) assert that the positive attitude of the teachers would enable them to easily integrate technologies into teaching and learning. This assertion is based on Woodrow's (1992) recommendation that a positive attitude towards technologies results in successful change in educational practices. Further, teachers' experience and skills determine their attitude towards the integration of technologies in the process of teaching and learning (Hermans, Tondeur, van Braak and Valcke, 2008). Some teachers might have a positive attitude towards technology but may lack confidence in their skills to use technologies for

teaching; therefore, there is a need for a balance between skills and attitude (Ghoord, 2013). Other factors that influence teachers to use technology in teaching and learning are gender and age (Biraham, 2019 and Hermans et al., 2008).

Teachers had the following to say about their competence after the teacher professional development from the University of the Free State that they attended through the project:

The continuous assessment and training which happened after school during project implementation has equipped teachers with knowledge therefore improving their confidence in teaching and using mobile technologies in class. One teacher said:

"I have improved a lot, I can now use the tablet without asking others to help. I knew little about using computers and tablets for teaching and learning before the project was implemented in our school. After we got teacher training from UFS, this gave us the necessary skills and knowledge to use technology for teaching our learners."

In addition, another teacher agreed that their knowledge has since improved as a result of the project, teacher said:

"I can say my level of competence is at 70% now. The only thing I cannot do is fix the tablets when they are not broken; otherwise, I am able to assist other teachers who did not do the TPD. I can search for information on the tablets and even ask learners to look for specific things on the tablets."

Another teacher agreed that tablets were here to stay, and that it is better for both learners and teachers to start using the tablets for teaching and learning:

"We need to transform from old ways of teaching to new ways as both learners and teachers. Because technology keep on changing and improving, learners will learn more. I as an educator will have acquired more experience in using the tablet. However, we need more devices for learners."

Some teachers were anxious when they started training, but improved as their ICT exposure, skills and knowledge increased due to teacher professional development. Initially teachers were anxious and scared of the technologies as well as using them in teaching, however as time went on teachers had this to say:

"When we did teacher professional development with the ICT4E team, I felt like I am like my learners but now I am computer literate. This project has benefitted me a lot. I am now empowered to use technology in both my personal and professional life."

The project improved teacher's knowledge as can be heard from this teacher quote: "I *did not have any knowledge on ICT and how to use them in class; now I can say I am computer literate because of the project."*

In support of the improved skills another teacher said "*I can use technology to collect resources on the internet and do research. I am able to use some apps that I could not use before. My teaching approach and method has improved."*

Teachers also want to change from the traditional classroom as indicated by this teacher "*The traditional way of teaching and learning is time consuming; the tablets make it easier to access content."*

Another outcome for teachers which is improve ICT knowldhe and skills for teachers was successfully achieved as indicated in this quote:

"I knew little about using computers and tablets for teaching and learning before the project was implemented in our school. After we got teacher training from UFS, this gave us the necessary skills and knowledge to use technology for teaching our learners. I have improved a lot; I can now use the tablet without asking others to help."

4.1.2 Comparison of the research results with other similar studies

In Chapter two, literature from similar past and present studies was reviewed. Some of those studies have similar findings while others present differences with the incumbent study. In this sub-section, the researcher compares past and present studies' findings to this one. Ghoord (2013) found that teachers' attitudes determine their use and integration of ICT in teaching and learning; some teachers have positive attitudes, while others have a negative attitude. In this study the researcher discovered that, in the beginning when teachers had not yet gone through training, they had a negative attitude towards ICTs and were anxious to use the tablets in teaching and learning. This finding is also echoed by Daya (2017), who found that teachers with a positive attitude are more likely to accept and use ICTs in teaching and learning than those that have a negative attitude. Matyila (2019) discovered that, despite the teacher professional development that teachers did with the University of the Free State, some were still hesitant and not sure about using technologies for teaching and learning. The tablets were not used daily because teachers had other commitments to deliver and report on besides the use of ICT in teaching and learning.

Ghoord (2013), who carried out his study in the Capricorn district, also discovered that, prior to any ICT intervention in the schools, most teachers would have had little exposure to technologies for teaching and learning. ICTs were mostly used for administrative purposes. This finding is similar to the incumbent study. During the baseline assessment for the intervention, most teachers from the three schools had not used ICTs for teaching

and learning. However, they all owned cell phones and were using them for various personal reasons.

This study found that, after the intervention had been implemented, teachers reported to have confidence in their skills to use technologies for teaching and learning. This finding is similar to that of Langenhoven (2015) and Ghoord (2013). Langenhoven (2015) adds that teachers and learners felt empowered after the implementation of ICT initiatives in schools. The findings of this project are similar: learners ask for tablets even in the teacher's absence, in order to use the tablets to search for educational content or playing the preloaded educational games. Matyila (2019) also discovered that teachers reported that they were able to use tablets in classrooms to show learners how to do research and projects on the tablets.

In this study, some teachers claimed that learners' performance has improved since the intervention was implemented in their schools. That is, they are now more disciplined and attend school more. Langenhoven (2015) also made the same observation in her 2015 study which took place in the Eastern Cape.

This sub-section discussed the themes of teacher professional development, technology adoption and implementation as well as teachers' perceived ICT competence. When executed well, teacher professional development seems to be the preferred path for the implementation of ICT interventions in schools. Teachers advocate for continuous regular training when they use ICTs in teaching and learning. This training would encourage them to adopt and implement technologies in teaching and learning. There is a difference in teachers' ICT perceptions before and after ICT training when interventions are implemented in school. Teachers should be at the heart of any intervention that is implemented in schools, especially for teaching and learning. The next section answers the research question on the importance of using and integrating mobile technologies in teaching and learning.

4.2 The importance of applying and integrating mobile technologies in teaching and learning

In this sub-section, the researcher answers the question: "why is it important to use and integrate mobile technologies into teaching and learning?" The themes identified for this question are technology integration, perceptions and attitudes towards technology and

barriers to technology, because they provide an opportunity for us to understand the importance that the research participants placed on mobile technologies in the process of teaching and learning. The identified themes assist in unpacking the reasoning behind why teachers find it important to use and integrate mobile technologies in learning and teaching.

4.2.1 Empirical research results—Responses to the research question: Why is it important to use and integrate mobile technologies in the process of teaching and learning?

4.2.1.1 Technology integration

Technology integration is described as a process to include ICTs in all aspects of education and training (Bariham, 2019). This includes administration as well as methods to support effective teaching and learning. It is meant to "support and enhance students' engagement in meaningful learning and attainment of curriculum objectives" (Bariham, 2019, p56). ICT integration goes beyond the use of technology in classrooms; it involves the use of technology to acquire skills such as critical thinking, collaboration, evaluation of content, problem-solving, accessing information online, as well as to present and communicate with others beyond the classroom (South African Department of Education, 2006 and Tondeur, 2007).

Technology integration into education goes beyond the provision of ICT infrastructure and connectivity (Tondeur, 2007), and needs some conducive factors to be successful. The curriculum needs to be aligned to the use and integration of ICT in teaching and learning (Bariham, 2019 and Tondeur, 2007). Teachers find it hard to integrate ICT into teaching and learning because there is no time for ICT on the timetable; the focus is mostly on examinations, whether internal or external (Bariham, 2019 and Mdlongwa, 2012). There are no incentives to motivate teachers to be innovative in their classroom teaching (Mdlongwa, 2012 and Bariham et al., 2019). There are no policy guidelines on how to integrate ICT in teaching and learning (Mdlongwa, 2012 and Bariham et al., 2019). There is usually no coordinated collaboration between teachers to share ideas on how to include ICT in teaching and learning (Mdlongwa, 2012 and Bariham, 2019).

The participants were asked why it is important to use and integrate technologies in teaching and learning. All participants agreed that technologies are here to stay, and that schools therefore need to make changes to accommodate the use of technologies in teaching and learning.

Most teachers recognised the importance of technology in teaching and learning, this improves the skills and knowledge of teachers and allows them to understand their learners capabilities and weaknesses. One teacher said:

"Technology is here to stay, teaching has changed; learners use cell phones, computers and laptops for their schoolwork. It is important for teachers to also catch up with ICT skills to be able to use technologies in the classroom, complimenting the learner skills."

Technology is recognised as an enable to ease of learning and grasping concepts in the learning process especially where learners are expected to grap new terminology. A teacher indicated that:"*Technology makes lessons more understandable and interesting because learners are able to research more on their learning areas."*

Another teacher reported that it is easy to teach using technology and easy for the learners to also grasp content because they are more receptive to lessons when they are able to play, see and touch objects during lessons. The mobile technology allows them to view videos of lessons, touch the table as they search for content and play with the different applications that are preloaded on the tablet. Two teachers noted that:

"Tablets make learning easier because learners learn more easily when they can play and touch objects like tablets, and this tends to help them remember lessons better."

"There is a lot of quality teaching and learning using the internet and tablets. Technology is important in the process of teaching and learning in schools."

More teachers supported the notion of learning through touch, play and see for the learners. In addition to helping the learners receive lessons easier than normal teachers also found it easy to teach using mobile technologies. A teacher said:

"The project was very good. It helped me as an educator to be more effective in teaching using tablets. It also helped me to learn different teaching strategies that could help learners to prosper in their studies in the university level. The project helped us integrate mobile technologies in teaching and learning."

The technology reduced the teacher's workload as learners are able to either work alone or in groups using the mobile technologies. In addition, teachers able to focus on learners that needs more attention than others during lessons as others continue learning alone or in groups. This is noted in the two quotes from teachers below:

"Communication with learners is easy. The tablets reduce the teacher's workload, as the learners are able to work on their own while the teacher only focuses on learners that need special attention."

"Tablets make it easier to teach in large classrooms; the teacher is able to focus on those learners that need specialised individual attention while other learners use tablets."

Although the learners were not allowed to take the tablets home, teachers noted that learners continued learning on their own devices at home as learning is no longer restricted to the classrooms only.

"Technology expands learning to the home environment. Learners can access content on tablets even when they are at home. It does not have to be restricted to the classroom."

"When using tablets learning does not stop as learners can take the tablets anywhere, they are going. Learning never stops; learners are always learning something from the tablets through the various applications available on the tablets, as well as searching the internet for topics of their interest"

4.2.1.2 Barriers to technology use

Many reasons have been reported as hindrances to technology integration into the process of teaching and learning, for example: lack of access and availability of technology and appropriate software for teaching and learning; the limited skills and experience of teachers regarding ICT usage; and teachers' beliefs about how to integrate ICT into teaching (Moyo, 2017).

Access to ICT in the classroom remains one of the biggest challenges when it comes to integration and use of technologies in the process of teaching and learning (Bariham, 2019 and Mdlongwa, 2012). Learners must share the available ICT resources in classrooms, and sometimes the only ICT resource available is the teacher's computer; therefore, the learners do not have a hands-on experience of technology use (Bariham, 2019, Mabila, 2017 and Habibu, Al-Mamun and Clement, 2012). The Department of Education in South Africa is aware of the lack of ICT resources in schools; therefore, they collaborate with various stakeholders to improve the ICT footprint in schools (Beyers and Hlala, 2015, Chisago and Lesame, 2017 and Mathevula and Uwizeyimana, 2014).

Teachers assert that technologies improve the accessibility of more resources for teaching and learning. Learners' attitudes towards learning also become more positive as technologies open a completely new world of relevant learning materials for them.

Teachers had this to say to support the assertion that tablets make more content accessible for teaching and learning, whether preloaded or via the internet:

"*Learners are given an opportunity to learn through other mediums in addition to the traditional way of teaching and learning."*

"…Technologies in education improve access to new content for both teachers and learners…"

"Leaners will be able to learn English better, especially word meanings and pronunciation."

"Tablets make learning easier, because learners learn more easily when they can play and touch objects like tablets and this tends to help them remember lessons better."

4.2.1.3 Perceptions and attitudes of teachers towards technology

Bariham, et. al. (2019) outline three necessary conditions for teachers to effectively use and integrate technologies into their teaching process: First, the belief and perception that technology will not cause any disturbances in the classroom; second, teachers should perceive technologies as an effective means of delivering pedagogy; and third, teachers' belief that they can control how technology is used and integrated into the process of teaching.

Some teachers claim that the availability and use of tablets in schools have improved learners behaviour, performance and class attendance.

"Mobile technology has a positive impact on teaching and learning; learners started coming to school regularly and absenteeism reduced significantly."

"…Tablets improve the cognitive development of learners rapidly…"

"It is important to use mobile technologies in teaching and learning, because learners come to school more and they have access to more content on the tablets."

Teachers recognises ICT as an effective means of delivering pedagogy through the following assertions:

"Mobile technologies accelerate the process of evaluating leaning results and give students and teachers the opportunity to track progress quickly"

"Learners' understanding of the content of their subjects has improved. Using the tablet is more convenient as we do not use the traditional way of teaching; saves time and no chalkboard."

"Learners are the ones that are impacted more because they have now improved in their marks and come to school more"

Teachers also perceive the technologies to make a difference in their teaching and learning in the schools, some teachers had this to say in terms of the technology in teaching and learning:

"…Through internet I am able to get more information. My learners become independent learners at home (working on their own). If we can start using the tablets again for teaching and learning and the school gives me an opportunity to teach using technologies, then I would continue. All learner tablets were stolen, so we need new ones in order to continue using and integrating them in teaching and learning"

Although the schools were given learner tablets teachers indicated that these tablets were not enough to cater for the number of learners at the school,therefore there is shortage and they need more tablets for teaching and learning.

"The project is good but the tablets are not enough for the learners, as we have a high learner enrolment in the school. The project was excellent. Teachers were rejuvenated. New teaching strategies and methods were learned. New teaching skills were also learned. We were able use new apps that we did not know about."

It is not just the attitudes of teachers that the project managed to effectively change but those of the learners and parents as well because parents started enrolling their kids in this schools as a result of the schools having new technologies for teaching and learning.

"The use of technology changes the attitude of both learners and teachers. Learners' performance and understanding improve drastically. Teaching has improved and learners are eager to learn and use tablets, even when the teachers are not there."

However the schools were broken into and all tablets were stolen, this has prompted the SGB in some schools to start making investments in ICT procurement for teaching and learning.

"Initially when we had tablets it was great, because we saw changes in both teachers and learners. Some parents even enrolled their children at our school since we had tablets, but after they were stolen we find ourselves at a loss."

4.2.2 Comparison of the research results with similar studies

The integration of technologies in teaching and learning is influenced by a number of factors, ranging from technology availability, teachers' and learners' beliefs and perceptions towards technology and teachers styles of teaching (Bariham, Ayot, Andigi, Kiio and Nyamemba, 2019). This sentiment is also shared by Tondeur (2007) and Bariham et al. (2019). "Teacher beliefs and perceptions can be considered to be 'the individual conceptions about desirable ways of teaching and conceptions about how students come to learn' "(Hermans et al., 2008, p1501). Teachers' and learners' beliefs are created through life experiences and influenced by the context in which they grew up (Hermans et al., 2008 and Bariham et al. (2019). The more technologically experienced teachers are, the

more likely they are to integrate technologies into teaching and learning (Hermans et al., 2007 and Bariham et al., 2019).

The study by Mathevula and Uwizeyimana (2014) has summarised barriers to technologies as availability of resources, lack of teacher training and lack of support from school management and the department. This is echoed by Chigona, Chigona, Kayongo and Kausa (2010).

In this section, themes discussed were technology integration, barriers to technology use and perceptions and attitudes towards technology use. Barriers to technology are availability of resources, theft of ICT infrastructure from schools as well as teachers' planned time to integrate technologies into teaching and learning. The next section considers the factors that influence teachers to either use or not to use technologies for teaching and learning.

4.3 Teacher's motivation to apply and integrate mobile technologies teaching and learning.

This sub-section presents the empirical research results for the question "what factors influence teachers to use and integrate technologies in teaching and learning?" The theme technology implementation assists us in understating how ICT4E was implemented in schools. This project offered a top-down approach to technology implementation. The responses to the research questions would offer us an opportunity to understand how beneficiaries would like to have technologies implemented in their school environment, and what type of support they deem important to be able to implement mobile technologies in teaching and learning. The themes under discussion are barriers to technology use and integration as well as school management and support.

4.3.1 Empirical research results—Responses to the research question: What factors influence teachers to use and integrate mobile technologies in teaching and learning?

4.3.1.1 Barriers to technology use and integration

Administrative barriers exist that prevent teachers from using technologies in class, for example, an insufficient number of computers/tablets, limited internet connectivity and unstable electricity supply, limited availability of relevant software and lack of technicians for when the technology fails.

Teachers had this to say with regards to barriers that prevent them from applying and integrating mobile technologies into teaching and learning: All teachers indicated that the tablets were not enough to cater for all teachers and learners needs, they needed more. This is supported by the assertions from three teachers.

"The project is good, but the tablets are not enough for the learners as we have a high learner enrolment in the school…Give schools more tablets that are enough for all learners."

"Provide all teachers with mobile technologies for classroom teaching and for learners for research and writing exams."

"It has to be used by everyone in the school for the different learning areas and school subjects for research, downloading material for teaching and learning."

4.3.1.2 School management support

The South African Schools Act of 1996 (SASA) differentiates between governance and management, with each having two overlapping teams to ensure the smooth running of the school. The principal is responsible for the professional running of the school and the school management team (SMT), while the school governing body (SGB) is responsible for school governance. The principal is the member of both the SGB and SMT. In these schools, school management seems to support the use and integration of ICT into teaching and learning; hence, they were buying laptops for teachers' professional and personal development.

The schools seemed to be battling with crime, because all learners' tablets in two of the three schools were stolen; however, the schools have started making provisions to obtain other types of ICT such as laptops in the classroom to continue the momentum of the ICT4E intervention.

"The SGB is in the process of fundraising to buy each teacher a laptop. The SGB has started providing teachers with laptops for teaching and learning and their own personal development."

The project has successfully encouraged the use of ICT in teaching and learning and has empowered schools to recognise the importance of ICT in teaching and learning hence the commitment from SGB to procure laptops for teachers.

"The school has committed to buying three laptops per year for teachers as a way of integrating technologies in teaching and learning after the learner tablets were stolen.

The schools expressed a need for helping in getting more tablets especially after the theft that occurred at two of the schools.

"We need help with replacing the stolen tablets. Please assist us get more tablets that will be enough for all learners. I would definitely like to continue using the tablets; however, learner tablets were stolen from school."

4.3.2 Comparison of the research results with similar studies

Existing power relations in society determine how ICTs are used in teaching and learning. If men and women, girls and boys had equal rights in society, then this would be a game changer for technology implementation in schools (Bariham et al., 2019). According to Bariham et al. (2019) women are more likely to be anxious when it comes to using technologies in class, due to a lack of skills and confidence in the use of technology. In this study, most respondents were women and have reported that, after training, they do not have a problem using and integrating technologies into classrooms.

Male teachers, on the other hand, would be more positive than females towards the use of computers in classrooms (Bariham et al., 2019). Alabani (2015) agrees with Bariham et al. (2019) about barriers to technology use and integration. The author lists the following as hindrances: (i) teachers' knowledge of technology; (ii) teachers' frequency of using technology for personal purposes; (iii) teachers' frequency of using technology for instructional purposes in different content areas; (iv) teachers' attitudes toward technology; (v) teachers' self-confidence in using technology in teaching and learning; and (vi) school climate (Alabani, 2015). This study discovered opposing views to those of Bariham et al. (2019) and Alabani (2015), because the female teachers interviewed expressed positive attitudes towards technologies in teaching and learning, especially after they have observed learners coming to school more, saw their performance improving and observed more learners being interested in their school work to the extent that they would ask for permission to use tablets even when the teachers were not present in class.

In this sub-section, the researcher answered the questions related to teachers' motivation towards the use and integration of technologies in class, under the themes barriers to technology use as well as school management and support. The next section considers how to apply and integrate mobile technologies into teaching and learning.

4.4 Application and integration of mobile technologies into teaching and learning.

This sub-section presents the empirical research results for the question: "How can mobile technologies be used and integrated in teaching and learning?" The themes perceived ease of use and perceived usefulness were identified to assist us in understanding learners' reactions towards the use of technology in the process of teaching and learning. The researcher wanted to understand how learners react, because the researcher would like to conduct a study in future on the impact that mobile technologies have, with a specific focus on learners. The answers to the question would form a baseline as to how learners could be included on mobile technology use in the process of teaching and learning.

4.4.1 Presentation of the empirical research results - Responses to the research question: How can mobile technologies be used and integrated into the process of teaching and learning.

4.4.1.1 Community of practice in education for mentoring and support

To support the growth and development of teachers in informal contexts, schools and teachers should create communities of practice where teachers meet in order to share their experiences in the school environment. Communities of Practice "are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly" (Patton and Parker, 2017, p.352). Wenger (2000, p. 139) defines a community of practice as a "group of people informally bound together by shared expertise and passion for a joint enterprise". Communities of practice are voluntarily formed by people with a common interest; it can be teachers, nurses, doctors, lecturers, and others (Ali, 2011 and Rock, 2020). The groups can be small or big, and can occur within and across organisations such as schools. Communities of practice are different from management teams because they are informally created and have different agendas and interactions; however, one still needs approval from members to join a community of practice (Ali, 2011 and Patton and Parker, 2017).

The teacher is the main actor in the development of learners' abilities, competence and confidence to master the educational journey. In order to encourage teachers to continue playing this important role, there is a need to develop communities of practice for support and collaboration between and amongst teachers, to reflect and improve on their teaching

(Rock, 2020 and Patton and Parker, 2017). Communities of practice can be both physical and virtual.

Rock (2020) and Patton and Parker (2017) outline some benefits of communities of practice. First, communities of practice encourage information and knowledge sharing amongst teachers from across the world. Communities of practice encourage teacher development through informal channels. Second, teachers get instant feedback from others who might be experts in some learning areas. This is more prevalent in virtual communities of practice, where teachers do not have to meet physically before they can share their concerns and questions. Third, teachers do not want to work in silos anymore, and therefore collaborate with colleagues to breakdown the silo practice. Last, communities of practice do not necessarily have to be of teachers in the same geographical area; therefore, teachers benefit from the experiences of those who teach in different contexts and schools and can share lessons in order to influence change and improve their own contexts and schools.

The project was able to effectively bring the schools closer together to form communities of practice as one teacher noted that:

"The project was good and made all the three schools to come close to one another and the hand of helping is extended and, as I am speaking, we are one big family in all activities at schools."

The project has also successfully ensured that ICT use continue in this schools as the trained teachers committed to training other teachers who were not part of the project to integrate and use technologies in teaching and learning.

"The school plans to train all new teachers that join the school after the ICT4E teacher professional development to make sure that new teachers are prepared for teaching and learning using tablets, and ensure that they are knowledgeable and have the necessary skills to teach using tablets."

The teachers supported the notion of supporting the building and sustainability of communities of practice through sharing of ICT content for all learning areas not just for Mathematics and Physical Science. These quotes support the building of communities of practice as well as continued ICT skills learning for every teacher in schools. Two teachers clearly highlighted this when they said:

"This ICT teaching knowledge needs to be shared amongst all staff members to spread the use of technology in teaching and learning in the broader school community, not just for certain learning areas. Educators are encouraged to be in classes of those who are teaching using tablets, to see all what is happening in the classroom situation and then give some workshops to train them on how to use mobile technologies in their classrooms."

"Immediately after the teacher profession development training, the ICT champion came and trained all teachers that were not part of the project on how to use and integrate technologies in classroom during teaching and learning."

4.4.1.2 Inclusion of all learning areas for technology integration and relevant applications and software availability.

Teachers expressed the need to have all learning areas on the tablets, not just Natural Sciences (NS) and Technology. They also expressed the need to have relevant secondary schools' applications for teaching and learning.

"Technology should be used in all learning areas, not just for NS and Technology. This will ensure that learners have access to more content on the internet, using the technologies for learning, and teachers can also benefit because lessons will be more understandable as learners are exposed to a bigger content on the internet."

There is also a need for more applications that cater for all learning areas.

"We should download apps that are relevant for teaching all learning areas in schools to make it easier to integrate mobile technologies in the process of teaching and learning."

Teachers also supported getting more content either pre-loaded or through the internet for other learning areas.

"We need more content for the secondary phase to do projects and investigations for subjects like creative arts and technology."

"We can download relevant content for our learners and ourselves for use during the process of teaching and learning."

4.4.1.3 Sustainability

Meyer, Marais, Ford and Dlamini (2017, p. 464) define sustainability as "as the ability to sustain the anticipated benefits of the project or programme, over an appropriate period of time, for pre-defined project participants." The intervention does not seem as if it will be sustainable due to the issues that the teachers raised. The Department of Basic Education needs to plan for adverse situations such as the COVID-19 pandemic, as well as for a full roll-out of mobile technologies in all schools of South Africa.

The first teacher said:

"We had planned to make sure all teachers are ICT competent, even after the project team has left the school. We wanted to make sure that all teachers are trained, and we organised communities of practice

with other schools to support each other in the use of ICT, but due to COVID-19 we had to change how we do things and ICT training was no longer done as things were different."

The second teacher said:

"Due to Covid19, it is impossible to train new teachers on how to use tablets; this is sad because some teachers are not equipped to teach learners using technologies, because they were not part of the teachers selected for the TPD that the ICT4E offered in collaboration with the University of the Free State"

Another teacher said:

"Technology should be used in all learning areas, not just for NS and Technology. This will ensure that learners have access to more content on the internet; using the technologies for learning and teaching can also benefit because lessons will be more understandable as learners are exposed to a bigger content on the internet."

Teachers also raised the issue of having preloaded content and relevant teaching applications on the tablets. Teachers also expressed the need to have more ICT infrastructure available—especially tablets for both teachers and learners—in order to have a bigger reach.

One teacher said:

"*We should download apps that are relevant for teaching all learning areas in schools to make it easier to integrate mobile technologies in the process of teaching and learning. We can download relevant content for our learners and ourselves for use during the process of teaching and learning."*

Another teacher said:

"We need more content for the secondary phase to do projects and investigations for subjects like creative arts and technology."

Another teacher added:

"It has to be used by everyone in the school for the different learning areas and school subjects for research, downloading material for teaching and learning. Provide all teachers with mobile technologies for classroom teaching and for learners for research and writing exams."

4.4.2 Comparison of the research results with similar studies

In the study by Mathevula and Uwizeyimana (2014), school management and support play an important role in the use and integration of mobile technologies in teaching and learning. This study also discovered that the school management in the three schools is of a high standard because, after the tablets were stolen in the schools, the SG as well as the principal were finding money to buy laptops for all teachers for their professional and

personal development. The teachers did not have to contribute anything towards the procurement of the laptops.

In a study by Chigona, Chigona, Kayongo and Kausa (2010), the researchers discovered that the principals of the schools that successfully integrated ICT into teaching and learning were at the forefront of the initiative; they reported that s/he expressed the need to change how things were done, especially with the introduction of technologies into teaching and learning. Although not strongly expressed in this study, the principals seemed to be heading towards the right direction of supporting teachers to use technologies in teaching through the procurement of new laptops for teachers.

Sustainability is usually a grey area in mobile learning and technology projects, because funders usually fund the projects in the short term and do not cater for sponsorships for technical support and training once they exit the projects (Ng and Nicholas, 2013). Long-term sustainability is a risk factor in many of these projects, even though interventions include ICT-related teacher training, infrastructure and e-resources (Meyer and Marais, 2014). Sustainability is an important aspect in these ICT projects, because they contribute to changes in society and could have a long-term impact on beneficiaries by changing and improving their lives through the introduction and adoption of new practices (Fullan, 2004).

In this section, themes that were discussed are communities of practice, inclusion of all teaching and learning areas on technologies and sustainability. The next section discusses the empirical research results and related research findings.

This chapter presented the research results. It was noted that there are various issues that can prevent technology integration in teaching and learning. However, this has not hampered the teachers in the three schools from accepting and using the mobile technologies in their teaching and learning. In terms of the objectives of the ICT4E outcomes for teachers, one can conclude that the project has succeeded in achieving these outcomes. The teacher also recognised the importance of teaching and learning with ICT as this made their lives easier and learners enjoyed their lessons more and were more receptive as they can play, touch and see the lessons on their tablets. The ease of ICT uses also motivated teachers to use technologies in teaching, form communities of practice to support each other through the process of ICT use in teaching and learning. This chapter laid the foundation for chapter 5 which focuses on discussing the research results and turn them into findings.

5 DISCUSSION OF RESEARCH FINDINGS

This section discusses, analyses and interprets the results presented in Chapter 4, and provides answers to the research questions posed in Chapter 1. To recap, this study is a summative evaluation of a mobile technology intervention with the aim of determining the outcomes of the intervention, with specific focus on teachers. The main objective of the research is to determine the use, acceptance and integration of mobile technologies into teaching and learning. The chapter commences with a discussion in Section 5.1 of the ICT4E intervention, which was implemented in the rural schools of the Seshego circuit, to determine if the planned and implemented objectives were plausible and could be achieved. Section 5.2 discusses the empirical findings of the importance of ICT in teaching and learning to determine why it is important to apply and integrate mobile technologies. Section 5.3 discusses the empirical findings of the research question pertaining to the factors that influence teachers to apply and integrate mobile technologies into teaching and learning; this is done to show the factors that either encourage or prevent teachers to apply and integrate mobile technologies into teaching and learning. The answers provide relevant stakeholders with an idea of where to start when they decide to roll out mobile technologies in teaching and learning. Section 5.4 details how mobile technologies can be applied and integrated into teaching and learning.

These discussions are based on the interpretive frameworks identified in Section 2.6 of this report. In Section 2.6.1, theories of technology use, acceptance and integration were discussed with respect to their influence on technology use and integration. The Technology Acceptance Model (TAM) and its extension the Technology Acceptance Model 2 (TAM2) were selected to interpret the research results of this study.

5.1 The intended outcomes of the information and communications technology for education (ICT4E) intervention with specific focus on teachers.

The TAM posits that individuals' use of technology is influenced by two constructs, namely, perceived ease of use and perceived usefulness (Davis, 1986). These constructs are determined by external factors, namely, behavioural intention (Briggs et al., 1998), habit (Geffen, 2003), subjective norms and image (Davis, 1986). Davis (1986) postulates that the use and acceptance of an information system (mobile technology for this study) can be predicted by the motivation of the user to use the information system. The

motivation to use an information system is influenced by how easy the system is when it comes to functionality and use. Three factors are assumed to influence user motivation, namely, perceived usefulness, perceived ease of use and the attitude towards the information system (Marangunić and Granić, 2015).

To summarise, the ICT4E intervention was commissioned by one government department in collaboration with various stakeholders to deploy mobile technologies in rural schools of the Seshego circuit, in order to influence and improve teaching and learning using mobile technologies. Before the deployment of the mobile technologies and teacher professional development (TPD), the monitoring and evaluation team carried out a baseline assessment with the intention of understanding (i) the teachers' ICT exposure before the intervention was implemented; (ii) the teachers' experiences with applying and integrating ICTs in teaching and learning; and (iii) their attitudes towards the application and integration of technologies into teaching and learning.

ICT4D projects are implemented to improve the quality of education in schools and influence how teachers and learners behave towards the technology. The developments that are implemented should be easy to use and available to all educators, administrators and learners. ICT in education is transforming the schooling ecosystem and has influenced procedures and processes as well as organisational management arrangements (Gómez-Ramirez, Valencia-Arias and Duque, 2019). ICT offers new concepts and ways of teaching, learning and school administration (Gómez-Ramirez, Valencia-Arias and Duque, 2019).

Teachers should be at the heart of technology application in the process of teaching and learning. Teacher professional development should focus on teaching and learning with mobile technologies, rather than on the mere use of mobile technologies (Ramorola, 2013 and Meyer and Gent, 2016). Teachers therefore need to focus on guiding learners on how to use and maximise technologies in their process of learning (Ramorola, 2013 and Meyer and Gent, 2016). Technology integration is governed by teachers, who act as facilitators for the improved application and use of technologies in teaching and learning (Ramorola, 2013). The emphasis is placed on how to teach using the tablet, rather than on how to use a tablet (Schaffer and Richardson (2004).

Teachers need more time for training that includes pedagogy, skills as well as ICT use in teaching (Bariham, 2019). Lack of ICT training prevents teachers from designing lessons that include the application of mobile technologies in teaching and learning (Bariham,

2019 and Botha, Herselman, Musgrave and Jaeschke, 2018). This affects the teachers' confidence to use ICT in teaching and learning. Teacher professional development should equip teachers with creative and flexible skills to develop their own instructions and classroom facilitation techniques, and to control how learners engage with the technology in class (Bariham, 2019).

Teachers are an important catalyst to mobile technology use in teaching and learning; therefore, it is important to place more emphasis and devotion on influencing their perceptions and increase their confidence in applying mobile technologies in teaching and learning (Pynoo et al., 2011). For this reason, teacher professional development should focus on changing teacher perceptions towards the application and use of technologies in general; this would have an influence on how they perceive technologies for teaching and learning.

5.2 The importance of applying and integrating mobile technologies in teaching and learning

Many stakeholders want to improve the quality of education. This is done in various ways, including through the provision of all ICT educational infrastructure needed by learners, administrators and teachers. Mobile technologies in education are important because they assist learners in gaining 21st century skills, while teachers also improve their ICT skills and knowledge in order to move away from traditional ways of teaching towards new and improved approaches.

Teachers and learners are active agents in the process of teaching and learning; they are able to pursue a strategy that improves their teaching and learning processes. Mobile technologies offer teachers and learners access to information and content that would not have been accessible with traditional chalk-and-duster methods of teaching (Ozdamli and Cavus, 2011). Mobile technologies expand teaching and learning beyond the classroom; learners and teachers are able to independently choose where their learning takes places besides the classroom (Vinu, Sherimon, and Krishnan, 2011).

The assumption of the TAM model is based on the individual's use and acceptance of technology; it does not take into account environmental and organisational characteristics that can influence the use and acceptance of information systems (Matyila, 2019). Davis (1989) described the perceived usefulness as the user's motivation to use the technology if they deem it to be useful to their work environment and can assist them to deliver on

the objectives of their jobs. Perceived ease of use is described as the ease with which the system is used for everyday activities.

Chigona et al. (2010) assert that a lack of mobile technology skills, knowledge and competence are the main reasons behind the lack of mobile technology application and integration into teaching and learning. One is said to be technologically competent when they are able to use a range of technology hardware and software for various reasons, such as teaching and learning in education (Pynoo et al., 2011). These researchers support the assertion that technology competence predicts the application and integration of technologies into teaching and learning. Investments should be made in ICT teacher professional development in order to complement traditional teacher training methods to improve the ICT skills and competence of teachers to continue applying and integrating technologies into teaching and learning (Norton, Mcrobbie and Cooper, 2000). Teacher training usually increases teachers' confidence to apply technologies in teaching and learning and improves teachers' ICT skills and knowledge. The technology is perceived to be useful for both their professional and personal lives because they become much more exposed and fluent in the application of technologies for teaching and learning.

Teachers continued to attend training offered through the intervention because they deemed the training relevant to improve their job performance, as well as how learners receive and react to the technologies in teaching and learning. TAM2 posits that the acceptance and use of technology is influenced by an individual's perceptions of the technology as relevant and useful in their work environment and assisting them in delivering quality work to both the schools and the learners (Sargolzaei, 2017). The training offered by the University of the Free State improved the teachers' status in the schools, as they could now train other teachers to apply and integrate technologies into teaching and learning. This training of other teachers also improved their skills, knowledge and experiences as people who have accepted and used the technology in teaching and learning, as well as supported other teachers who did not attend the TPD offered through the ICT intervention.

5.3 Teachers' motivation to apply and integrate mobile technologies in teaching and learning

Various factors influence teachers to use technologies. First, teachers use and integrate technologies in education because it improves their skills, knowledge and experience to

work with technologies in class. It gives them confidence to impart their knowledge to their learners. Second, teacher's perception of technology influences the use and integration of technology into teaching and learning. Third, the easier it is for teachers to use the technologies, the more they will use the technology. If teachers perceive technology as useful and important for them and their learners, then they are more likely to use it for teaching and learning. Fourth, culture and age influence how people accept and use technologies. The older people grew up without technologies; therefore, their use thereof would be much more limited than younger people. Experiences and culture influence how people perceive technology, regardless of their age and gender. There is a need for parents who are involved in their children's education—those who will safeguard the schools to prevent theft and vandalism of ICT infrastructure in schools and report to the relevant authorities if there is theft.

Teachers are demotivated to use technologies in teaching and learning for various reasons. Moyo (2017) asserts that, first, there is lack of appropriate technology and software for teaching and learning. Second, teachers have limited skills on how to integrate and use technologies into teaching. Third, teachers' beliefs and attitudes influence how they integrate technologies into the process of teaching and learning. Last, different technologies are delivered to schools with the promise that they will deliver a "revolutionary education system through teaching and learning"; however, this technological integration is not well coordinated and therefore ends up not changing education at all. Therefore, the discrepancies between and the actual application and integration of ICT into schools motivate researchers to focus on the difficulties and challenges those teachers encounter in their jobs, thus preventing them from integrating ICTs into teaching and learning.

Ramorola (2013) purports that the environment needs to be prepared to accept new developments, for example, technologies cannot be used in teaching and learning if the schools are not prepared to change to accommodate the application of ICTs in teaching and learning. The traditional way of teaching is not receptive to the use of technologies, as the teacher is perceived to be the one with the most knowledge; it is not about collaboration between teachers and learners, but rather a superior relationship that of teachers to learners.

Teacher commitment plays an important role when it comes to ICT use in the classroom. Insufficient resources also play a role in the poor integration of mobile technologies into teaching and learning (Ramorola, 2013). There is a lack of ICT-skilled teachers who will

lead and champion ICT integration into schools (Ramorola, 2013). There are also safety and security issues such as theft and vandalism that demoralise schools from procuring ICT infrastructure. There is a lack of proper maintenance and operations procedures and technicians to assist with technical problems. Parents are not involved in their children's education, and they could assist in reducing theft and vandalism in schools, for example, by raising funds for extra employees or by working as general workers and security officers to prevent theft and vandalism of ICT infrastructure in schools.

Bagchi, Cerveny, Hart and Peterson (2003) assert that culture plays an important role in the uptake and adoption of technologies. This is based on the 1994 study by Straub (1994), who found out that culture played an importance role in the use and acceptance of technology. Technophobia, which can be described as the fear of using technologies, seems to be one of the factors influencing the application of technologies in teaching and learning (Ramorola, 2013). Hence, the assertions that teachers need to be skilled to start using technologies is correct; however, there is a need to take into account that, even when equipped with ICT training on how to use ICT in teaching and learning, teachers might experience the fear of using technologies in class. This is consistent with one of the constructs of TAM2 called computer anxiety. This occurs when an individual is faced with the possibility of using technologies for teaching and learning (Sargolzaei, 2017).

TAM separates implementation and context characteristics such as training, support, user involvement, user expectation, culture, age and gender from technology characteristics (Adams, Nelson and Todd, 1992). The ITC4E intervention offered teachers as well as ICT technicians the training to support the application and integration of technologies into teaching and learning. This improved the teachers' attitudes towards the mobile technologies because they knew there was someone available to assist them in cases of ICT system failure. The presence of technical assistance in schools reduces anxiety towards ICT and supports teachers and learners to gravitate towards the application of technologies in teaching and learning (Hew and Brush, 2007). Groves and Zemel (2000) purport that there are factors which influence technology integration, namely, training of teachers, availability of content, and technical and administrative support. Likewise, Williams (2003) emphasises that technical and administrative support influence the use and applicability of ICT for teaching and learning.

Despite the fact that infrastructure and technical support are vital factors to motivating teachers to apply mobile technologies in teaching and learning, school technology leadership is an important aspect of educators' use of computer technology in teaching

(Anderson and Dexter, 2005). Researchers Stigzelius (2011) and Herselman et al. (2017) assert that a principal who supports technology application and use can influence teachers' adherence to ICT plans and implement the ICT vision for the schools.

A strong school leadership and management is a catalyst for technology plans and vision to be implemented in teaching and learning. Lai and Pratt (2004) assert that school-level management is important to assess and evaluate what is possible and what is not when it comes to the application of technologies in teaching and learning. School leadership is able to work with teachers to eliminate barriers that prevent them from effectively applying technologies in teaching and learning. Similar to teachers, school principals need to be prepared and trained on how to lead in times of technology application in teaching and learning, to be able to appoint human resources that will assist with ICT vision achievement, as well as to procure ICT that would suit the context of the school (Becker, Ravitz and Wong (1999). Principals who are well prepared to lead in schools of excellence where ICT is fully integrated into teaching and learning need to have clear ideas of how technology can assist teachers and learners to achieve their goals in the process of teaching and learning (Flanagan and Jacobsen, 2003).

5.4 Application and integration of mobile technologies into teaching and learning.

The process of integrating ICTs into teaching and learning is multifaceted and requires a large number of committed stakeholders. Teachers play an important role when it comes to use and integration of technologies into teaching and learning. However, teachers would not be able to apply ICT in teaching and learning without the school leadership's support.

The following process can be used to integrate ICT in teaching and learning. First, technology infrastructure (tablets, internet connectivity, electricity, technicians, maintenance plans, etc.) should be made available for everyone in schools. Second, schools should draft their own ICT policy based on the national e-education policy. The school's ICT policy should include how teacher professional development will be coordinated in the school, the timetable for ICT use, and roles and responsibilities for replacing and fixing the ICT in cases of system failure. Third, hire ICT technicians who will do operations and maintenance of the technologies. Fourth, involve the district and province to include the use of ICT for teaching and learning as part of teachers' key

research areas, so that they see the need to use ICT instead of seeing it as a distraction as their use is not measured in the teachers' KPIs. There is currently no proper plan and framework on how to integrate technologies into teaching and learning.

Ramorola (2013) asserts that there is limited experience on how to adopt and integrate technologies into teaching and learning. In addition, the researcher explains that, even in schools where technologies are available, the focus seems to be on learning about the technologies rather than using it for teaching and learning. Technologies are mainly used for administration, such as printing of reports and examination papers, as well as for keeping marks of all the learners rather than integrating them into teaching and learning. The teacher in the classroom is still perceived as the knowledge sharer and dispenser; hence, technologies have not been given a chance to alter the old ways of teaching and learning.

There is no proper plan on how to apply and integrate mobile technologies into teaching and learning. Tondeur, Van Braak and Valcke (2007) assert that South African schools have to draft school-level policies on how to apply and integrate technologies into teaching and learning. This policy drafting should involve all school stakeholders such as learners, parents, teachers and principals. A joint understanding of how ICTs should be included in teaching and learning will improve the use thereof. There is no school-level policy that outlines how to apply and integrate technologies into teaching and learning. There is also no formal implementation plan in the e-Education policy drafted by the department of Education on the application of ICT in teaching and learning. Successful integration of ICT in teaching and learning is realised when teachers, learners, principals and parents understand the value of ICT (Tondeur, Van Keer, Van Braak and Valcke, 2007).

This research puts teachers at the heart of the intervention to measure the progress of the ICT4E intervention; therefore, the research considers teacher professional development (TPD) as the means to achieving positive progress towards technology integration, with a specific focus on teachers. There is a framework that guides how technologies should be implemented in teaching and learning; however, evidence of progress and implementation does not exist (Meyer and Gent, 2016). There is no national TPD curriculum, and the little TPD that exists is driven by individuals and the TPD service providers (Meyer and Gent, 2016).

This chapter focused on the discussion, interpretation and analysis of the research results that inform the research questions of the study. The discussions were based on constructs from two models, namely, TAM and TAM2. Overall, users accept and use technologies based on two constructs, namely, perceived ease of use as well as perceived usefulness. These constructs are influenced by external factors that predict the attitudes, motivation and behaviours of technology users to either use or reject the system. Herselman et al. (2017) assert that, in order to see changes such as the use and integration of ICT in teaching and learning, there is a need to engage in interventions that target the whole education system to effect change at all levels of the system, from the national department to the learners in schools. Meyer and Gent (2016) propose that a focus on ICT interventions should be on teacher professional development, because teachers are at the heart of teaching and learning and control and influence how the teaching and learning process progresses.

6 SUMMARY, CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

This chapter presents a summary of the research report. It starts with a summary of the background, literature review, research methods as well as the presentation and discussion of the research results. It proceeds to highlight the issues that stood out in each chapter, and the study's limitations. Lastly, the study makes recommendations for future research. Table 6.1 depicts the summary, conclusions, limitations as well as recommendations of the study.

Effectiveness of the mobile technology intervention in rural schools: The case of Seshego circuit in Polokwane district	
Summary	**Conclusions**
-Research conceptualisation	-Research conceptualisation
- Teacher centric	-Teacheres are at the heart of teaching and learning
- Determine ICT intervetion sustainability	- ICT intervention focus on TPD for teachers
-	- Put some things in place to ensure sustainability
-Conceptual framework	-Conceptual framework
- TAM used to intepret the results	-a combination of other models including TPCK can be used
- CF assisted in carrying out the research	- Extensive literature review before draft conceptual framework
- CF assisted us in collecting insightful data to answer the RQ	- CF is important as it guides how the study progresses
-Research strategy, design, procedure and methods	-Research strategy, design, procedure and methods
-qualitative case study research design	-Case study - deep understanding of the case of Seshego
- Availability of teachers problematic	-
- Data analysed manually using spreadsheet	-
-Empirical research results	-Empirical research results
-ICT are useful for teaching and learning	-Positive attitute towards ICT
- Barriers to ICT interventions exists	- Identified barriers that prevent ICT adoption
-	- Determine how to eliminate barriers
-Research findings	-Research findings
-Teachers positive towards ICT use	-ICT for teaching and learning is important
-Positive perceptions towards ICT	- Various reasons predict ICT use and acceptance
- Barriers preventing teachers to use ICT	-
Limitations	**Recommendations**
-Research conceptualisation	-Policy implications
-the research could include both learners and teachers.	-Formulation of school level ICT policy based on the e-Education policy
-Funders should plan for their exit and sustainability	-The inclusion of ICT use in the teacher KPI/KPA
-	-A bottom-up approach to technology implementation in schools
-Conceptual framework	-
- the use of a different intepretive framework	-
- Measurement of outcomes immediately after funders exit	-Future research
-	-An evaluation of all the 24 schools
-Empirical research results	-An evaluation of the intervention outcomes - focus on learners
- Evaluation done soon after project completion	-Annual ealuation of the intervention
- After a year maybe we might get a different results	-
-Sustainability is not guaranteed	-
-Research findings	
- Sustainability is not guaranteed	
-Results cant be generalised	

Table 6.1: Summary, conclusions, limitations and recommendations. (Source: Author)

6.1 Summary

The purpose of the research is to determine the effectiveness of the ICT4E intervention in rural schools of the Seshego circuit in the Polokwane district. The aim is to find out how teachers' behaviour has changed towards the use and integration of mobile technologies into teaching and learning. In addition, the aim is to find out from the teachers' perspective why it is important to integrate technologies into teaching and learning, and to identify barriers that prevent teachers from using and integrating technologies into teaching and learning. Last, the researcher wants to document how teachers think ICT should be integrated and used in teaching and learning.

Past and present literature was reviewed to draft a conceptual framework for guiding the study. This plan assisted us in carrying out the research. Although riddled with challenges, it made it possible for us to gather data on the use of ICT in teaching and learning. It is difficult to draft a conceptual framework; one needs to do an extensive literature review before attempting to develop this master plan. The Technology Acceptance Model (TAM) was used to interpret the research results and turn them into findings. TAM is the basis for all technology acceptance models in information systems as well as in other fields. The use of a qualitative research strategy benefitted this research. Insightful accounts of how the use and integration of technologies unfolded in the schools were captured. A case study benefitted this research because the researcher was able to determine changes in a small context in order to support future interventions, to be implemented in similar contexts.

This type of study had not been done before in these schools. The intervention implemented gets an opportunity to be evaluated in order to understand the outcomes, with specific focus on teachers. Evaluations inform project beneficiaries and funders on how well the intervention has progressed. These evaluations offer funders an opportunity to improve how they engage with project beneficiaries in future projects.

Based on the conceptual framework drafted for this study, data was collected from teachers in the three schools that constitute the Limpopo Cluster. Due to COVID-19, it was problematic to get hold of teachers; however, the researcher managed to conduct three interviews and obtain nine completed questionnaires to gather the data. People were not allowed to visit schools unless in special circumstances; this also prevented us from carrying out classroom observations of the use of the mobile technologies in teaching and learning. The collected data was captured, collated and analysed using a Microsoft Excel

spreadsheet. Processing and analysing data manually are time consuming. Identifying themes also needs an experienced researcher to be able to identify what themes emerge from the data especially in circumstances where the researcher is novice and might not be able to differentiate between what to include or exclude from the data.

The data collected assisted in answering the research questions for this study. There were four research questions that had to be answered. Each question was answered through themes emerging from the data. The discussion on each question was summarised by comparing the research results of this study to other similar studies. The intended outcomes of the ICT4E intervention were partly achieved. This was measured through various ways, such as reviewing how many teachers attended the TPD classes and how many graduated in the end. The researcher also assessed the attitude of teachers towards mobile technologies to determine how teachers used and integrated mobile technologies into teaching and learning. The teachers' ICT competence and confidence had increased after the ICT teacher professional development.

Technology adoption and implementation can be observed through various ways, namely, technology use, teachers' confidence and competence and teachers' perceptions towards ICTs in teaching and learning. The barriers that prevent teachers from using and integrating mobile technologies into teaching and learning were identified. These include an inadequate supply of ICT infrastructure, poor availability of electricity, lack of teachers' ICT skills and knowledge on how to use and integrate technologies into teaching and learning. The data also assisted us in mapping out a process that teachers suggest could be adopted for mobile technology application and integration into teaching and learning.

The TAM was used to discuss the research results. The TAM predicts the use and acceptance of technology through two constructs, namely, perceived ease of use and perceived usefulness (Davies, 1989). These two constructs are influenced by external factors such as age, gender, resource availability, attitude, skills, knowledge and experience. Teachers in the schools were trained on how to use mobile technologies in teaching and learning; this assisted in improving the teachers' skills, knowledge and attitudes towards the mobile technologies. The teachers' confidence increased, which resulted in positive perceptions and attitudes towards the mobile technologies; therefore, they adopted them for teaching and learning.

6.2 Conclusions

The research aimed to carry out a summative evaluation of a mobile technology intervention in rural schools of the Seshego circuit to determine mobile technology integration into teaching and learning at the level of the teacher. Based on the qualitative case study, research methods and procedures, it can be said that teachers have started to integrate mobile technologies into teaching and learning; however, they experienced barriers that prevented them from fully using and integrating mobile technologies. Barriers reported by the teachers include inadequate availability of mobile technologies, theft and vandalism in the schools and lack of time to include the mobile technologies as they have to report on their teaching responsibilities, which does not include the use of mobile technologies for teaching and learning.

This research was carried out in order to determine if teachers' behaviour has changed towards the use of mobile technologies in teaching and learning since the intervention was implemented in the schools. The main problem of the ICT4E intervention is sustainability. To ensure that ICT4E interventions are sustainable, and the benefits of the programmes continue even after the project implementers have left, there is a need to continuously and regularly measure the milestones, ensure that the beneficiaries understand the benefits that come with the intervention and can use the interventions after the funders have exited the intervention.

The TAM predicts how users accept and integrate technologies into teaching and learning. People are influenced by external factors to accept and use technologies in their work. Teachers' use of mobile technologies depend on the type of support and schools that they are part of. Teachers are optimistic when it comes to using mobile technologies for teaching and learning; however, there are barriers that prevent them from effectively using and integrating mobile technologies into teaching and learning. Teacher professional development should be made compulsory for all teachers, especially when it comes to regular ICT training.

The competence and confidence of teachers had improved after the ICT teacher professional development. This was possible because teachers were taught different strategies of coping with the use of mobile technologies during teaching and learning. Using and integrating technologies into teaching and learning improve the quality of education; improve teachers' competence, skills, knowledge and confidence; assist with basic technology implementation and adoption and improve teachers' attitude towards

ICT for teaching and learning. ICT use and integration is possible and doable in schools; however, there is a need to eliminate the barriers that prevent schools, teachers and learners from applying technologies for teaching and learning. Mobile technology integration can be viewed as a process that starts with technology adoption and implementation for teaching and learning in schools.

6.3 Limitations

The study had a number of limitations. First, due to the COVID-19 pandemic, school visits were not allowed unless under special circumstances; therefore, face-to-face interviews with the teachers were not possible. As this is qualitative research, the researcher could not observe the teachers' non-verbal communication cues, which sometimes offer more answers than words can. Classroom observation of the use of mobile technologies in teaching and learning was also not possible, as visits were not allowed in schools. This impacted on the availability of teachers for telephonic interviews. The problem posed by the focus on teachers only relates to the fact that this intervention was not meant for teachers only; it was intended to measure changes at all levels that where the intervention intended to change the course of teaching and learning. There are no KPA/KPIs that measure teachers' use of ICT for teaching and learning; ICT teacher professional development and the use of mobile technologies in teaching and learning are not viewed as important by teachers, as they must satisfy other KPIs that are set for them.

Second, the study would benefit greatly if the researcher could interview other project stakeholders such as the training providers, some of the monitoring and evaluation team members and teachers who did not undergo training. This would have offered us a view from people who observed the use and integration of mobile technologies in teaching and learning, as well as how they perceived and understood if the intervention has achieved some of its objectives with specific focus on teachers.

Third, the research could be replicated with a larger group of schools and the use of a different research methodology. The study could be repeated annually to continue measuring and observing the behaviour of teachers when interacting with learners using the mobile technologies; this would enable observation of the impact of technologies on learners' behaviour and could even include how the technologies have impacted on school attendance and class performance. Further, the use of case study qualitative research

methods could be affected by the researcher's experience, knowledge and skills as one of the team members that implemented the ICT4E intervention in the schools under study.

Fourth, a study could be done that focuses solely on the impact of mobile technologies on the learners to determine what changes occur when learners interact with their teaching using mobile technologies instead of through the tradition way of teaching. The research could include the impact of technologies on the learners' marks and general performance in schools.

Fifth, monitoring and evaluation of projects should be planned from project conception, instead of as an afterthought or done when there are some funds left. Measuring of intervention outcomes sooner after project funders have exited the project can offer false hope for the project sustainability. When the project had just ended, teachers are still enthusiastic about the project and hence report their improved competence and confidence optimistically. The information is still fresh in their minds. The COVID-19 pandemic slowed down teachers' use and integration of teaching and learning using mobile technologies. Therefore, this study could be repeated in six months' time to check if the befits of the intervention still exists and are benefitting the beneficiaries.

6.4 Recommendations

This section covers the recommendations emanating from this study. First, future interventions of ICT in education should ensure that there is buy-in from all important stakeholders in education, from national, to provincial, to district to circuit to schools, to support the use and integration of mobile technologies into teaching and learning. Both top-down and bottom-up approaches should be used in implementing technologies in education. This gives everyone an opportunity to influence how mobile technologies can be optimally applied in teaching and learning. Each stakeholder input is taken into consideration.

Second, schools, principals, teachers and learners cannot sustain the benefits of the interventions on their own; project funders and implementers have to set up a support system that will ensure the benefits of the intervention continue to grow. The support starts with ensuring that there are operations and maintenance plans in place for when the ICT systems fail. Assign roles and responsibilities to everyone to support the application and integration of technologies in teaching and learning. Continuous ICT teacher professional development should be available for teachers who are already in

schools, while universities should change their curriculum to include compulsory ICT courses that teach teachers how to use technologies in teaching and learning (Herselman et al, 2019). Teachers are aware that times have changed; therefore, their teaching methods need to adapt to the changes. However, they do not know how to start this process (Ramorola, 2013), and it is for this reason that teacher professional development has to be made compulsory for all teachers.

Third, the profile of the teachers in these schools indicates a prevalence of older teachers; therefore, there is a need to recruit and train younger enthusiastic and energetic teachers to kick-start the implementation of the e-learning policy (Beyers and Hlala, 2015). In this same vein, the Department of Education needs to collaborate with the Department of Higher Education to establish institutions of higher learning that will support the training of new teachers, by building a new set of skills and knowledge to support technologies in teaching and learning (White Paper on E-Education 2003). In every institution there must be a module where trainee teachers are taught how to integrate technologies in teaching and learning, to eliminate or use less of the tradition chalk and duster method.

Finally, when technologies are implemented in schools, each school's context must be taken into account. It cannot be a one-size-fits-all implementation when it comes to ICT integration into schools. There is a need to create school-level ICT policies, guided by the white paper on e-education, to implement technologies in teaching and learning. This will ensure that each school accepts and uses technologies based on their specific context and needs.

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APPENDICES

Appendix 1: Ethical Clearance

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

WITS SCHOOL OF GOVERNANCE
UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Research Office:
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Research Director:
Prof Pundy Pillay
Tel: 011 717 3501
Email: pundy.pillay@wits.ac.za

30 November 2020

Dear Ms Nare Joyce Mahwai

Title: Summative evaluation of a mobile technology intervention in rural schools of Seshego circuit
Student Number: 0301281k
Degree: Master of Management in the field of Governance
Ethics Clearance Number: *WSG-2020-33*

All candidates must satisfy the University's ethical standards for research. Your ethics application has been received and reviewed by the Wits School of Governance Human Research Ethics Committee.

Your ethical clearance has been approved subject to you getting permission to conduct research from all sites where research is conducted. The letter(s) of permission to undertake research must be submitted to the WSG Research Office and kept on file with your final proposal and other ethics documents.

You may commence your data collection under the guidance of your supervisor. In the event that the scope, methodology or nature of the research changes, you are required to submit another ethics application reflecting the changes.

The onus is on you as the candidate, with support from your supervisor, to ensure your research complies with university human research ethics policies and protocols at all stages of the research process.

It is recommended that you keep this letter in a safe place as you are responsible for ensuring you have proof of ethics clearance. You will need to lodge the ethics clearance / protocol number with Faculty before final submission of your research report. If you do not have an ethics clearance number, you are not permitted to graduate.

Please do not hesitate to contact me if you have any queries.

Yours sincerely

Professor Pundy Pillay
Research Director

Appendix 2: Permission letters

MOHLAPETSI SECONDARY SCHOOL PERMISSION

Nare Mahwai - Re: Request for permission to conduct research with teachers

From: Mohlapetse Secondary <mohlapetse@gmail.com>
To: Nare Mahwai <NMahwai@csir.co.za>
Date: 19 Oct 2020 12:36
Subject: Re: Request for permission to conduct research with teachers

Madam.

You're are heartily welcomed to conduct your interviews.

Regard

Mehlape K. P
Principal

On Mon, Oct 12, 2020, 3:46 PM Nare Mahwai <NMahwai@csir.co.za> wrote:

> Good day
>
> My name is Nare Mahwai. I am an employee of the Council for Scientific and Industrial Research (CSIR) and a final year student enrolled for Masters in Management at Witwatersrand university herein request for permission to conduct research at your school schools . with special reference to Mochocho, Mohlapetse and Matsiri schools. The schools were selected because they were part of the ICT4E project that was implememtend in the schools in the last 2 to 3 years by Department of Rural Development in collaboration with the CSIR.
>
> My research title is : Summative evaluation of a mobile technology intervention in rural schools: The case of Moletjie.
>
> My data collection tool will be an online survey questionnaire . I wont have direct contact with schools due to covid pandemic. I will use emails and cellular phones for communication purposes.
>
> I would appreciate it a lot if the response is on the school letterhead if possible. Hoping that my plea be given a due consideration.
>
> Regards
> Nare Mahwai
>
> Email: NMahwai@csir.co.za
> Contacts: 072 906 9811/064 401 2012

MOCHOCHO PRIMARY SCHOOL



P.O Box 7686
Oa-Mabotja
0731

MOCHOCHO

Tel No: 015 223 6351

ENQUIRIES : NEKHAVHAMBE A (PRINCIPAL)

DATE : 20/10/2020

CELL NO : 0783755702

TO : YOURSELF :(NARE MAHWAI)

RE –RESPONSE TO YOUR REQUEST TO DO RESEARCH WITH TEACHERS.

THANK YOU FOR YOUR EMAIL AND AN INTEREST TO DO RESEARCH IN OUR SCHOOL.

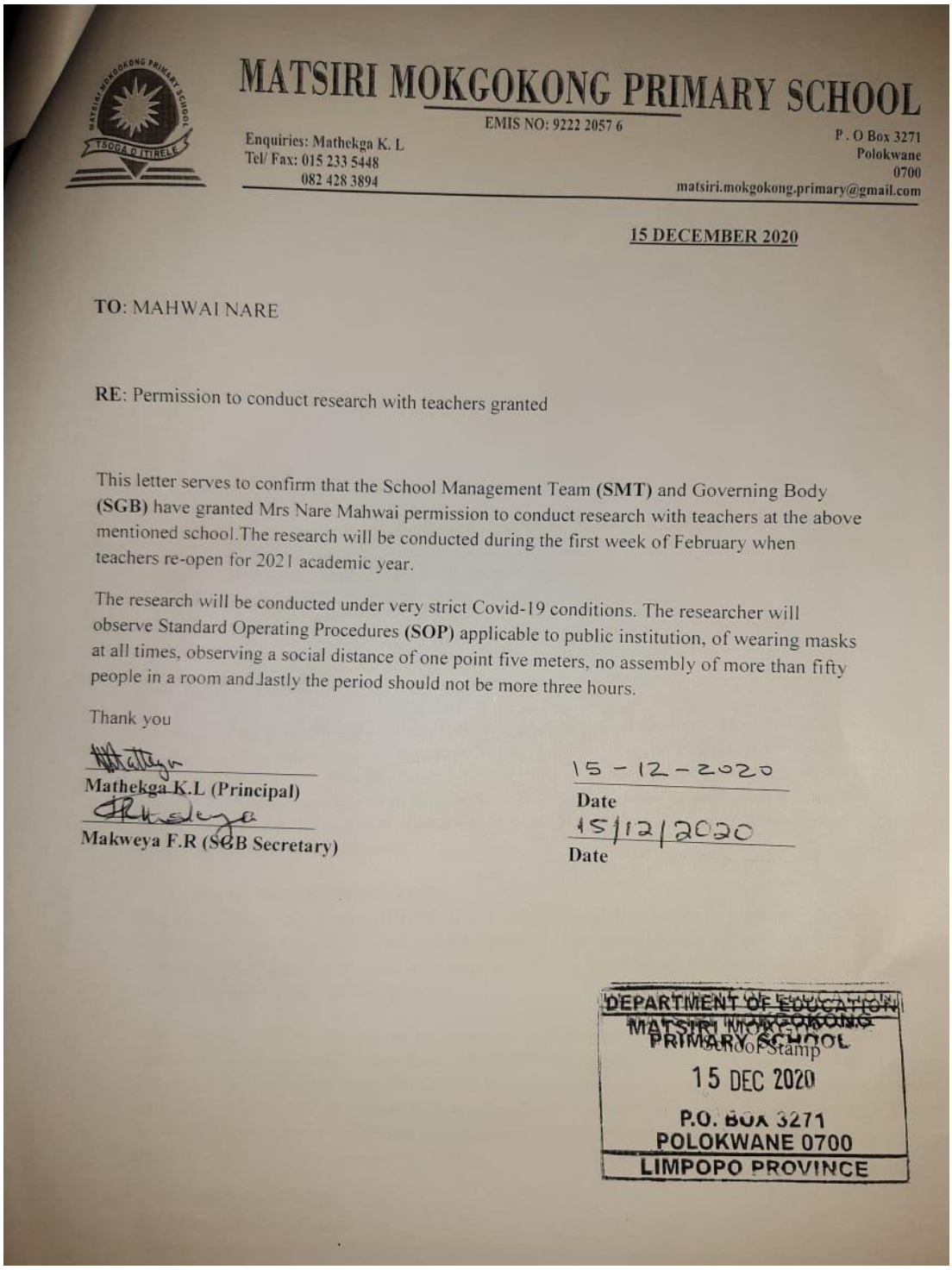
WE GRANT YOU PERMISSION TO CARRY OUT YOUR RESEARCH. THE RESEARCH SHOULD NOT INTERFERE WITH TEACHING AND LEARNING. PRIOR ARRANGEMENT SHOULD BE MADE WITH TEACHERS TO MINIMISE DISRUPTIONS ON TEACHINF AND LEARNING.

KIND REGARDS

A NEKHAVHAMBE (PRINCIPAL)



MATSIRI MOKGOKONG PRIMARY SCHOOL PERMISSION



MATSIRI MOKGOKONG PRIMARY SCHOOL

EMIS NO: 9222 2057 6

Enquiries: Mathekga K. L
Tel/ Fax: 015 233 5448
082 428 3894

P . O Box 3271
Polokwane
0700
matsiri.mokgokong.primary@gmail.com

15 DECEMBER 2020

TO: MAHWAI NARE

RE: Permission to conduct research with teachers granted

This letter serves to confirm that the School Management Team **(SMT)** and Governing Body **(SGB)** have granted Mrs Nare Mahwai permission to conduct research with teachers at the above mentioned school.The research will be conducted during the first week of February when teachers re-open for 2021 academic year.

The research will be conducted under very strict Covid-19 conditions. The researcher will observe Standard Operating Procedures **(SOP)** applicable to public institution, of wearing masks at all times, observing a social distance of one point five meters, no assembly of more than fifty people in a room and lastly the period should not be more three hours.

Thank you

Mathekga K.L (Principal)

15 - 12 - 2020
Date

Makweya F.R (SGB Secretary)

15/12/2020
Date

DEPARTMENT OF EDUCATION
MATSIRI MOKGOKONG
PRIMARY SCHOOL
15 DEC 2020
P.O. BOX 3271
POLOKWANE 0700
LIMPOPO PROVINCE

School Stamp

Appendix 3: Data Collection instrument

You are requested to complete the questionnaire that forms part of a research study conducted by Ms. Nare Mahwai in partial completion of her Masters in Management degree from the University of the Witwatersrand under the leadership of Dr. K. Wotela. You were selected as a possible participant in this study because your school was selected as part of the 24 schools, which was the beneficiaries of the ICT4Education initiative. The research aims to improve the quality of teaching and learning in a rural context through the introduction of proven technologies, frameworks and approaches that have been tested in a rural South African context, creating an enhanced teaching and learning process. The approach recommended in this document is centred on developing a sustainable implementation that aims to provide the plan required to achieve sustainability of the initiative beyond the involvement of the various stakeholders. The reason for completing this survey is to assess the impact which the ICT4E initiative has had on you as a teacher and your school.

This learning will enable recommendations and development of models to start scaling these resources to other areas in the district, the province and the country. **Your response will be treated confidentially and will be used for research purposes only.** The consent form which you have completed at the beginning of the training is still binding.

SECTION A: Educators Biographical Information

The purpose of collecting this biographical information is to check whether there are differences in how the initiative is received by different types of participants.

Name of Teacher:_____

Name of School:_____

Today's date:			/			/				
	D	**D**		**M**	**M**		**Y**	**Y**		
Cellphone no:										
Alternative no:										
Your gender (Tick One)	**O Male**				**O Female**					
Your date of birth			/			/				
	D	**D**		**M**	**M**		**Y**	**Y**		
Where do you live (Name of Town /										

Village)?	
Your home language: (Tick one)	**O Afrikaans** **O English** **O IsiNdebele** **O IsiXhosa** **O IsiZulu** **O Sepedi** **O Sesotho** **O Setswana** **O IsiSwati** **O Tshivenda** **O Xitsonga** **O Other……**
What is your highest academic qualification? (Please tick one)	**O Grade 12/Standard 10/Form 5/Matric** **O NTC I** **O NTC II** **O NTC III** **O Certificate with less than grade 12/STD 10** **O Diploma with less than grade 12/STD 10** **O Certificate with grade 12/STD 10** **O Diploma with grade 12/STD 10** **O Bachelor's Degree** **O Bachelor's Degree and Diploma** **O Honours Degree** **O Higher Degree (Masters, Doctorate)** **O Other** **Other please specify……** **……**
How long have you been a teacher? (Tick one)	**O 3 Years or fewer** **O 4 – 9 Years** **O 10 – 19 Years** **O 20 – 29 Years** **O 30 – 39 Years**
How long have you taught at your current school?	**O 3 Years or fewer** **O 4 – 9 Years** **O 10 – 19 Years** **O 20 – 29 Years** **O 30 – 39 Years**
Please indicate if you hold any of the following position	**O HOD (Phase Head or Subject Head)** **O Deputy Principal** **O Principal** **O None of these**

s at school?				
Your school name				
Does the school have computers for Educators?	**O No**	**O Yes – for administration**	**O Yes – we have a computer lab or trolley**	**O Yes – some of us have computers**
Does your school use an IT Support person?	**O No (I don't know)**	**O As needed** **O Volunteer** **O Paid**	**O Yes – As a service contract**	**O Yes – as an employee**
Does your school have tablet computers?	**O No**	**O Yes – For educators only**	**O Yes –For learners only**	**O Yes for both educators and learners**
Which of the following do you have at home? (You can tick more than one)	**O Computer or Laptop**	**O Tablet Computer or other digital device**	**O Internet**	**O Printer**

Which grades are you teaching in 2018?	**O Grade R**	**O Grade 1**	**O Grade 2**	**O Grade 3**
	O Grade 4	**O Grade 5**	**O Grade 6**	**O Grade 7**
	O Grade 8	**O Grade 9**	**O Grade 10**	**O Grade 11**
	O Grade 12			

Are you part of a professional learning community, community of practice or any formal or informal group of teacher's network?	**O Yes**	**O No**
	If Yes Please explain **……. ……..**	**…… ……..**

Which learning areas or subjects are you teaching in 2018? **(There is a separate block for each phase – only tick learning areas or subjects that you teach in each phase**	**19.1 Tick learning areas in this block if you teach in the Foundation Phase (Grades R – 3)**			
	Home Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setswana**	**O Sepedi** **O Tshivenda** **O Other**
	First Additional Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setswana**	**O Sepedi** **O Tshivenda** **O Other**
	Non Languages:	**O Life Skills**	**O Mathematics**	
	19.2 Tick learning areas in this block if you teach in the Intermediate Phase (Grades 4 – 6)			
	Home Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setwana**	**O Sepedi** **O Tshivenda** **O Other**
	1st Additional Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setwana**	**O Sepedi** **O Tshivenda** **O Other**
	2nd Additional Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setwana**	**O Sepedi** **O Tshivenda** **O Other**

Which learning areas or subjects are you teaching in 2018? **(There is a separate block for each phase – only tick learning areas or subjects that you teach in each phase**	**Non Languages:**	**O Life Skills** **O Natural Sciences & Technology**		**O Mathematics** **O Social Sciences**
	19.3 Tick learning areas in this block if you teach in the Senior Phase (Grades 7 - 9)			
	Home Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setwana**	**O Sepedi** **O Tshivenda** **O Other**
	1st Additional Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setwana**	**O Sepedi** **O Tshivenda** **O Other**
	2nd Additional Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setwana**	**O Sepedi** **O Tshivenda** **O Other**
	Non Languages:	**O Creative Arts** **O Life Orientation** **O Natural Sciences** **O Technology**	**O Economic and Management Sciences** **O Mathematics** **O Social Sciences**	
	19.4 Tick learning areas in this block if you teach in the FET Phase (Grades 10-12)			
	Home Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setwana**	**O Sepedi** **O Tshivenda** **O Other**
	1st Additional Language			

	O Afrikaans **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setwana**	**O Sepedi** **O Tshivenda** **O Other**
	2nd Additional Language **O Afrikaans** **O Sesotho** **O Xitsonga**	**O English** **O IsiXhosa** **O Isiswati**	**O IsiNdebele** **O IsiZulu** **O Setwana**	**O Sepedi** **O Tshivenda** **O Other**
Which learning areas or subjects are you teaching in 2018? **(There is a separate block for each**	**Non Languages:**	**O Accounting** **O Agricultural Science** **O Business Studies** **O Consumer Studies** **O Geography** **O Information Technology** **O Life Sciences** **O Mathematics** **O Religion Studies**	**O Agricultural Management practices** **O Agricultural Technology** **O Computer Applications Technology** **O Economics** **O History** **O Life Orientation** **O Mathematical Literacy** **O Physical Sciences** **O Other** **Other Please specify……** **……**	

phase – only tick learning areas or subjects that you teach in each phase			

Section B: Prior Training

This section tells us about your prior exposure to ICT training.

Have you been trained on any of the following? (Tick either yes or no for all items)

Basic introduction to computers	**Yes**	**No**
How to use word processors (e.g. WORD) and spreadsheets EXCEL)	**Yes**	**No**
Technical skills support	**Yes**	**No**
Integrating ICT in curriculum using the worldwide web	**Yes**	**No**
Integrating ICT in classroom projects	**Yes**	**No**
ICT leadership and management	**Yes**	**No**
Collaboration using Internet tools	**Yes**	**No**
Basic usage of ICT's in education	**Yes**	**No**
I have received computer training and I didn't know what it was for	**Yes**	**No**

SECTION C: TEACHER USES OF TECHNOLOGY

This section tells us about the technology that you have used to date.

Do you use technology for any of the following personal applications? (Tick all that apply for each item)

	No, I don't do this yet	**I do this on a cell phone or tablet computer**	**I do this on a computer at home**	**I do this on a computer at school**	**I do this on a computer at an internet cafe**	**I do this on a shared computer at home or at school**
Social Networking (e.g. Facebook, Twitter, LinkedIn)						
Chat / Instant Messaging (Skype, WhatsApp, Google Chat, BBM)						
Personal Email communication						
Internet Banking						

Research (e.g. Google) for personal purposes						
Recording videos						
Recording sound clips						
Taking photos						
Accessing Apps						

Have you used technology for any of the following school applications? (Tick all that apply for each item)

	No	**On a cell phone or a tablet computer**	**On a computer at home**	**On a computer at school**	**At an internet cafe**
Finding information on the Internet (for class)					
Typing examination papers					
Recording marks					
Developing teaching resources					
School administration tasks					
Reading, watching and listening to content for own professional development					
Developing digital content (e.g. making a video clip showing an experiment or explaining a concept)					
Using Apps in class to teach					
Using educational videos with a projector for teaching in class					
School email communication					

(Please tick Yes or No)

Does the school ban the use of cellphone by learners	**Yes**	**No**
Do you communicate with your learners at home via WhatsApp or email	**Yes**	**No**
Learners use ICT in the classroom	**Yes**	**No**
Learners use ICT at home to do homework	**Yes**	**No**
Learners use ICT at school for personal purposes	**Yes**	**No**

Section D: Perceived Self-Confidence in Integrating ICT

This section tells us how confident you feel to integrate ICT at the moment. Remember there is no right or wrong answer and even if you do not feel confident at the moment, you may say so!

How much do you agree with the following statements?	**Completely Disagree**	**Disagree**	**Agree**	**Completely Agree**
I can select appropriate software to use in my teaching				
I can use Presentations (e.g. PowerPoint) in my class				
I can design technology-enhanced learning activities for my students				
I can use email to communicate with my students				
I can teach my students to select appropriate software to use in their projects				
I can teach my students how to make their own web pages				
I can use the Internet in my lessons to meet certain learning goals				
The tablet computer can help students understand concepts more easily				
I can refer the learners to relevant information on the Internet to support my teaching				

Section E: School Climate and support

This section tells us about the support for ICT integration in your school.

How much do you agree with the following statements?	**Completely Disagree**	**Disagree**	**Agree**	**Completely Agree**
I would like to know how to teach using technologies				
Other educators encourage me to integrate tablets / computers in teaching and learning				
I would like to teach using ICT's				
The school's ICT coordinator or committee encourages me to integrate tablets / computers in teaching and learning				
The principal encourages me to integrate tablets / computers in teaching and learning				
6. The district official encourages me to integrate tablets / computers in teaching and learning				
I often exchange ideas about technology integration with other educators				
There are other educators in my school who use tablets / computers in teaching and learning				
In staff meetings, we frequently discuss the subject of integrating tablets / computers in the school curriculum				

Educators in my school are well informed about the value of tablets / computers in teaching and learning				
A variety of tablet / computer software is available for use in my school				
The technical support in my school is adequate				
The instructional support (i.e. support provided by the HOD or principal to guide teaching and learning) in my school is adequate				
The technical infrastructure in my school is adequate				

Section F: Digital Literacy3 and ICT acceptance4

This section tells us the level of your digital literacy based on three dimensions namely; the technical dimension, the cognitive dimension and the socio-emotional dimension. The first dimension is the technical dimension:

How much do you agree with the following statements?	**Completely Disagree**	**Disagree**	**Agree**	**Completely Agree**
1. I know how to solve my own technical problems				
2. I can learn new technologies easily				
3. I keep up with important new technologies				
4. I know about a lot of different technologies				
5. I can teach my students to select appropriate software to use in their projects				
6. I have the technical skills I need to use ICT for learning and to create artefacts (e.g. presentations, digital stories, wikis, blogs) that demonstrate my understanding of what I have learnt				
7. I have good ICT skills				

The second dimension is the cognitive dimension:

How much do you agree with the following statements?	**Completely Disagree**	**Disagree**	**Agree**	**Completely Agree**
1. I am confident with my search and evaluation skills with regards to obtaining information from the Web				
2. I am familiar with issues related to web-based activities e.g. cyber safety, search issues and plagiarism				

The third and final dimension is the socio-emotional dimension:

How much do you agree with the following statements?	**Completely Disagree**	**Disagree**	**Agree**	**Completely Agree**
1. I frequently obtain help with my teaching work from my friends over the Internet e.g. through Skype, Hangouts, Facebook, Blogs				

2. ICT enables me to collaborate better with my peers on teaching concepts and learning opportunities				

I think my level of digital literacy is (Please circle on a scale of 1 – 10 below)

1 2 3 4 5 6 7 8 9 1

Very Low Very High

The next set of questions relate to attributes of ICT acceptance in teaching:

How much do you agree with the following statements?	**Completely Disagree**	**Disagree**	**Agree**	**Completely Agree**
1. I expect to find ICT useful in my teaching work				
2. Using ICT will enable me to exercise my teaching work easier				
3. Using ICT will enable me to positively teach more learners				
4. I intend to continue using ICT for my teaching rather than to discontinue using it				
5. My intentions are to continue using ICT for teaching rather than traditional teaching				
6. I would like to discontinue using ICT for teaching				
7. ICT use for teaching is clear and understandable				
8. Teaching using ICT will be easy and I believe my learners will experience little challenges with it				
9. ICT will introduce challenges to teaching learners				
10. I anticipate learners to be motivated in learning with ICT methods				
11. I believe that my learners will not progress when learning using ICT				

Section G: Improved school practice and sustainability

This section aims to understand how the project has created a positive attitude towards teaching and learning and the teachers view on sustainable use of technology at the school.

Have you seen an improvement in the attendance of the learners since they started using tablets in class?	
Yes	**No**
Please explain	

Do you see a difference in the marks of the learners in those classes where the tablets are being used?	
Yes	**No**
Please explain	

Can you say the use of tablets in the classroom made a real difference in learners understanding the work better?	
Yes	**No**
Please explain	

Will you say the project (particularly the use of tablets) had a positive or negative influence on the learners?	
Positive influence	**Negative influence**
Please explain	

Did the attitude of the learners improve based on the use of tablets in the classroom?	
Yes	**No**
Please explain	

Did your school benefit from this project in the end?	
Yes	**No**
Please explain	

Did you as a teacher benefit from this project?	
Yes	**No**
Please explain	

Are you planning to continue using the tablets in future in your classroom?	
Yes	**No**
Please explain	

Are there any plans in place to train the other teachers who did not attend training?
Yes | **No**
If yes, please explain
Has the school made any plans for maintaining or replacing the technology to insure continuous use of technology at the school
Yes | **No**
If yes, please explain

What is the impact of mobile technology use and integration on the process of teaching and learning?
Please explain

Why is it important to use and integrate mobile technologies in teaching and learning?
Please explain
How can mobile technologies be used and integrated in teaching and learning?
please explain

Please give an overall remark about the project as a whole

Appendix 4: Consent form

CONSENT FORM TO PARTICIPATE IN RESEARCH

You are asked to participate in a research study conducted by Ms. Nare Mahwai in partial completion of her Masters in Management degree from the University of the Witwatersrand under the leadership of Dr. K. Wotela.. You were selected as a possible participant in this study because you are involved as a role player in the DRDLR ICT for Education project, and/or you have been provided with a tablet containing digital school content and we want to test how digital resources can enhance teaching and learning.

1. PURPOSE OF THE STUDY

The overarching aim of the DRDLR ICT for Education Project is to improve the quality of teaching and learning in a rural context through the introduction of proven technologies, frameworks and approaches that have been tested in a rural South African context, creating an enhanced teaching and learning process.

The objective of this research is to carry out summative evaluation of the DRDLRICT for Education project in order to document the use and integration of the mobile technologies in the process of teaching in learning. The lessons learnt from this study will provide a recommendation on how to implement future projects as well as inform educational policies on mobile technologies in schools. This learning will enable recommendations and development of models to start scaling these resources to other areas in the district, the province and the country.

2. PROCEDURES

2.1 Research procedures

Please note that your participation in the project and the research process is voluntary. You were trained by trainers from the University of the Free State and received training at NQF level 6. Some of the conditions of being part of the project was to:

- Allow the project team members to test how you use the tablet
- Participate in all project activities
- Use the tablet to assist you to support the district's teaching and learning activities at the schools so that you can support schools which wish to integrate technology into their classrooms.
- Secure the tablet: The tablet is a valuable device, and as with all items of value, act appropriately to ensure that the device does not get lost or is removed from your possession (i.e. stolen).

If you volunteer to participate in the research, we would ask you to do the following things:

i. Answer questions relevant to the use of the tablet
ii. Answer questions about the use of tablets in the education system especially for teaching and learning.

Questions will be asked during interviews (telephonic) and via questionnaires (email). Nare Mahwai who was trained in doing these will do data collections. All interviews will be audio recorded and will be kept confidential. The time it will require to complete the interviews will be half an hour.

3. POTENTIAL RISKS AND DISCOMFORTS

There are no risks involved in participation in this project and research study and there will be no physical or psychological discomfort to you.

4. POTENTIAL BENEFITS TO SUBJECTS AND/OR TO SOCIETY

Your input and advice will help us understand the value and the use of digital equipment and content in current teaching and learning in South Africa.

5. PAYMENT FOR PARTICIPATION

There will be no payment for your participation in the research.

6. CONFIDENTIALITY

Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Confidentiality will be maintained by means of limiting access to your data and only the researcher and supervisor will be able to access it. All data sheets that have been collected will be stored in a secure place for five years, after which they will be destroyed and not shared with any other person without your permission.

Any subsequent report or journal will not mention your name or other personal data and so will not be possible to identify participants. *The information received during the project will only be used for research purposes and not be released for any employment-related performance evaluation, promotion and/or disciplinary purposes*.

7. PARTICIPATION AND WITHDRAWAL

If you volunteer to be in this study, you may withdraw at any time without consequences of any kind. You may also refuse to answer any questions you don't want to answer and still remain in the study.

8. RIGHTS OF RESEARCH PARTICIPANTS

You may withdraw your consent at any time and discontinue participation without penalty. You are not waiving any legal claims, rights or remedies because of your participation in this research study.

Signature of research participant or legal representative

The information above was described to me, _____by the Researcher Nare Mahwai in the language of my choice or this language was satisfactorily translated to me. I, _____ was given the opportunity to ask questions and these questions were answered to my satisfaction.

I hereby consent that the participant may participate in this study. I have been given a copy of this form.

Name of Participant

Signature of Participant (if applicable)

_____

Name of Legal Representative

_____ _____

Signature of Legal Representative Date

Signature of investigator

I declare that I explained the information given in this document to _____ [name of the participant] and/or _____ [name of the representative]. He/she was encouraged and given ample time to ask me any questions. This conversation was conducted in the language of his/her choice and where necessary this conversation was translated from _____ into_____by _____-

Signature of Investigator Date

Appendix 3: Information Sheet

PARTICIPANTS INFORMATION SHEET

You are requested to complete the questionnaire that forms part of a research study conducted by Ms. Nare Mahwai in partial completion of her Masters in Management degree from the University of the Witwatersrand under the leadership of Dr. K. Wotela. You were selected as a possible participant in this study because your school was selected as part of the 24 schools, which was the beneficiaries of the ICT4Education initiative. The research aims to improve the quality of teaching and learning in a rural context through the introduction of proven technologies, frameworks and approaches that have been tested in a rural South African context, creating an enhanced teaching and learning process. The approach recommended in this document is centred on developing a sustainable implementation that aims to provide the plan required to achieve sustainability of the initiative beyond the involvement of the various stakeholders. The reason for completing this survey is to assess the impact which the ICT4E initiative has had on you as a teacher and your school.

This learning will enable recommendations and development of models to start scaling these resources to other areas in the district, the province and the country. **Your response will be treated confidentially and will be used for research purposes only.** The consent form which you have completed at the beginning of the training is still binding.

Appendix 5: Interview Schedule

Improved school practice and sustainability

The aim is to understand how the project has created a positive attitude towards teaching and learning and the teachers view on sustainable use of technology at the school.

Have you seen an improvement in the attendance of the learners since they started using tablets in class?	
Yes	**No**
Please explain	

Do you see a difference in the marks of the learners in those classes where the tablets are being used?	
Yes	**No**
Please explain	

Can you say the use of tablets in the classroom made a real difference in learners understanding the work better?	
Yes	**No**
Please explain	

Will you say the project (particularly the use of tablets) had a positive or negative influence on the learners?	
Positive influence	**Negative influence**
Please explain	

Did the attitude of the learners improve based on the use of tablets in the classroom?	
Yes	**No**
Please explain	

Did your school benefit from this project in the end?	
Yes	**No**
Please explain	

Did you as a teacher benefit from this project?	
Yes	**No**
Please explain	

Are you planning to continue using the tablets in future in your classroom?	
Yes	**No**
Please explain	
Are there any plans in place to train the other teachers who did not attend training?	
Yes	**No**
If yes, please explain	
Has the school made any plans for maintaining or replacing the technology to insure continuous use of technology at the school	
Yes	**No**
If yes, please explain	

What is the impact of mobile technology use and integration on the process of teaching and learning?
Please explain

Why is it important to use and integrate mobile technologies in teaching and learning?
Please explain

How can mobile technologies be used and integrated in teaching and learning?
please explain

Please give an overall remark about the project as a whole

Appendix 6: Consistency Matrix

Questions/Hypotheses/Proposition		Attributes/variables		Data/information collection instrument		Data/information collection processing and analysis	
1	What is the impact of mobile teachnology use and integration on the process of teaching and learning?	1.1	Technology hardware	1.1.1	The questionnaire has questions with regards to technology hardware.		Telephonic interviews or email communication wull be used to gather data from the participants. Thematic analysis will
				1.1.2	Project documents have recorded about the use of technology hardware on schools. A review of the documents will assist with		A project documents will be reviewed to collect data with refgards to the variables and attributes. Themes will be identified for
				1.1.3			
		1.2	Technology software	1.2.1	The questionnaire has questions with regards to technology software.		Telephonic interviews or email communication wull be used to gather data from the participants. Thematic analysis will
				1.2.2	Project documents have recorded about the use of technology software in schools. A review of the documents will assist with		A project documents will be reviewed to collect data with refgards to the variables and attributes. Themes will be identified for
				1.2.3			
		1.3		1.3.1			
				1.3.2			
				1.3.3			

Questions/Hypotheses/Proposition		Attributes/variables		Data/information collection instrument		Data/information collection processing and analysis
1	Why is it important to use and interate mobile technologies in the process of teaching and learning?	1.1		1.1.1	The questionnaire has questions with regards to technology hardware.	Telephonic interviews or email communication wull be used to gather data from the participants. Thematic analysis will
				1.1.2	Project documents have recorded about the use of technology hardware on schools. A review of the documents will assist with	A project documents will be reviewed to collect data with refgards to the variables and attributes. Themes will be identified for
				1.1.3		
			Technology hardware			
		1.2		1.2.1	The questionnaire has questions with regards to technology software.	Telephonic interviews or email communication wull be used to gather data from the participants. Thematic analysis will
				1.2.2	Project documents have recorded about the use of technology software in schools. A review of the documents will assist with	A project documents will be reviewed to collect data with refgards to the variables and attributes. Themes will be identified for
				1.2.3		
			Technology software			
		1.3		1.3.1		
				1.3.2		
				1.3.3		

Questions/Hypotheses/Proposition		Attributes/variables		Data/information collection instrument		Data/information collection processing and analysis
1	How can mobile technologies be used and integrated in teaching and learning?	1.1		1.1.1	The questionnaire has questions with regards to technology hardware.	Telephonic interviews or email communication wull be used to gather data from the participants. Thematic analysis will
				1.1.2	Project documents have recorded about the use of technology hardware on schools. A review of the documents will assist with	A project documents will be reviewed to collect data with refgards to the variables and attributes. Themes will be identified for
				1.1.3		
			Technology hardware			
		1.2		1.2.1	The questionnaire has questions with regards to technology software.	Telephonic interviews or email communication wull be used to gather data from the participants. Thematic analysis will
				1.2.2	Project documents have recorded about the use of technology software in schools. A review of the documents will assist with	A project documents will be reviewed to collect data with refgards to the variables and attributes. Themes will be identified for
				1.2.3		
			Technology software			
		1.3		1.3.1		
				1.3.2		
				1.3.3		

Appendix 7: PAG LETTER

New Window | Help | Personalize Page

Research TitleSupervisorExaminer

ID:	0301281K	Name:	Nare Mahwai
Career:	C Masters (C) Degree	Student Career Nbr:	0
Program:	BCA01Master of Management	Program Action:	Matriculation
Attendance Type:	Full-Time	Status:	Active in Program
Latest YOS:	Year of Study 2		

Academic Plans Personalize | Find | View All | | First 1 of 1 Last

	Academic Plan	Description
Row 1	BFAPDSM60	Pub & Dev Sect Monitor & Eval

Title Find | View All First 1 of 1 Last

*Effective Date:
ResearchTyRESEARCH REPORT
*Status:

*Title:

Citation

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*Can Publish:
Release Date:

Ethics Number Find | View All First 1 of 1 Last

*Type:
Number:

Navigate To

MilestonesTitle/Supervisor/ExaminerTracking and Communications Status Code & Letter History

Research Title | Supervisor | Examiner

Thanks,

Mbali Nxumalo
Faculty Officer | CLM Faculty Registrar's Office

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UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG 100 | WITS FACULTY OF COMMERCE, LAW & MANAGEMENT

Faculty House (Block M), Ground Floor, Room 004,
Management Campus, Parktown, Johannesburg

From: Nare Mmonwa-Mahwai [mailto:nmmonwa@gmail.com]
Sent: Thursday, 29 April 2021 10:05
To: Mbali Nxumalo <Mbali.Nxumalo@wits.ac.za>
Subject: Re: Research title approval

Hi Mbali.

I still have not received the system generated PAG letter in my student email.

Regards,
Nare

On Wed, Apr 28, 2021 at 9:28 AM Nare Mmonwa-Mahwai <nmmonwa@gmail.com> wrote:

> Thanks. I will let you know.
>
> On Wed, Apr 28, 2021 at 9:27 AM Mbali Nxumalo <Mbali.Nxumalo@wits.ac.za> wrote:
>
> > Dear Nare

Appendix 6: Transcription

Nare: Good day sir. My name is Nare Mahwai as previously communicated. I hope you have the forms that I left at the schools for data collection. I am currently calling in my capacity as a student from Wits University to collect data for my master's studies. Please read the information sheet send to the schools and ask anything that you do not understand. The forms I have provided you also have a consent form that you need to sign to show that you volunteer to take part in this study. Your response will be treated confidentially and will be used for research purposes only. Do you consent to take part in the study?

Teacher: Is the consent form the same as the one we signed when we did training for the 24 schools project? Yes I want to take part.

Nare: They are similar but the one you signed was for participating in the project while the one you sign now is specifically for my studies.

Teacher: Thank you. Let us continue or should I start by filling in the questionnaire and we will start with the interview after?

Nare: Since the questionnaire will be collected later I suggest we start with the interview then you can complete the questionnaire after the call. I have some questions that have to do with sustainability of ICT4E interventions in schools with specific focus on the 24 schools project. I will ask a question, then you can respond yes or no and then explain why you either say yes or no. I will ask clarity questions for the answers that I do not understand clearly or need some more information. Are we together?

Teacher: Yes, we can continue.

Nare: Have you seen an improvement in the attendance of the learners since they started using tablets in class?

Teacher: Yes

Nare: Why do you say so?

Teacher: Learners showed a lot of improvement in their attendance before tablets were stolen from the school premises. Their performance had improved as they were excited because they never had a chance previously to use tablets in class. The new generation enjoys using phones time and again and when we give them enough time to work with tablets their class participation is very high during lessons. But the tablets we have are

not enough to cover the whole school. Observations is easy and the subject content is in segments so it is easy to understand. The learners are active and not bored. They enjoy being exposed to diagrams on a tablet rather than a textbook. Absenteeism rate decreases since we started using the tablets. Most learners are more advanced in ICT and they learn faster. In certain instances they even assist me with research and downloading content.

Nare: Thank you. Do you see a difference in the marks of the learners in those classes where tablets are being used?

Teacher: In the beginning of the project there was a change because learners where exposed to different method of teaching for example working station/learning station, where are able to solve many problems in a short period of time and be able to give feedback. However since the tablets were stolen, the tablets we have are not enough to cover the whole school. SO there has not been a change in the marks of the learners. There was a difference in the classes were tablets were being used as the learners had more resources for research. They started obtaining good marks. Most of the under achievers show improvement in their marks when writing tests. There has been an increase from lowest marks to higher marks.

Nare: How do you know that the tablets helped with improving marks?

Teacher: The learners spend more time on the tablets doing their homework because we have used different learning and teaching strategies which are used differently from traditional teaching e.g learning stations. This has improved their marks slightly. Learners had interest when they operate the tablets themselves. They feel proud when they search for solutions by themselves. ICT keeps them on their toes with excitement. But there were some learners who were not using the tablets fruitfully, mostly they were using them for playing games. We actually stopped using them for teaching and learning after the project team left/stopped coming to the school because the tablets were stolen. The biggest problem we have is vandalism.

Nare: Will you say the project (particularly the use of tablets) had a positive or negative influence on the learners?

Teacher: The project had a positive influence on the learners because the marks of those who were already using tablets in their classroom seemed to improve. Learners came to school on a regular basis and absenteeism was very low. Learners enjoy using the tablets in the classroom than textbooks. The learners who have tablets and

computers at home excel but those without tablets and computers at home do not excel in using the technology for learning. Level of concentration in the classroom is best when they use tablet. Discipline is great/ achievable. The learners are part of the 4th industrial revolution due to the use of tablets in the process of learning and teaching. This also includes teachers as well.

Nare: Did the attitude of the learners improve based on the use of tablets in the classroom? Please explain

Teacher: At first they were not at ease but as time went on, they started using the tablets even before lessons began, their attitude improved a lot. They started coming to school more and loved working with tablets as they had access to more content from the internet. Learners enjoy learning using the tablets because they understand more and like to use tablets most of the time. They are able to follow instructions that are logical and keep them to their norms and values. The learners concentrate better and the tablets motivates them to complete their given tasks. When we still had tablets before they were stolen learners in Physical Sciences were able to balance equations using tablets.

Nare: Did your school benefit from this project in the end? Please Explain

Teacher: Initially when we had tablets it was great because we saw changes in both teachers and learners. More educators learned how to use mobile tablet. Those whom has received training helped others so it has benefited the school positively but we need more devices to have a bigger reach in the school, the tablets provided were not enough. The personal relations and attribution between learners has improved in class. Located in a rural area I think the school has benefited because we could not afford all the devices. Some parents even enrolled their children at our school since we had tablets but after they were stolen we find ourselves at a loss.

Nare: Did you as a teacher benefit from this project? Please Explain

Teacher: As a teacher I benefitted because I got a free tablet and attended training on how to use ICT in teaching. I have improved a lot, I can now use the tablet without asking others to help. I knew little about using computers and tablets for teaching and learning before the project was implemented in our school. After we got teacher training from UFS, this gave us the necessary skills and knowledge to use technology for teaching our learners. The tradition way of teaching and learning is time consuming, the tablets makes it easier to access content. I can use technology to collect resources on the

internet and do research. I am able to use some apps that I could not use before. I did not have any knowledge on ICT and how to use them in class, now I can say I am computer literate because of the project. My teacher approach and method has improved.

Nare: Are you planning to continue using the tablets in future in your classroom? Please Explain

Teacher: I will continue teaching using tablets in class. This should be a contituation to show that it is of value to both learners and educators. WE need to transform from old ways of teaching to new ways as both learners and teachers. Because technology keep on changing and improving learners will learn more. I as an educator will have acquired more experience in using the tablet. COVID-19 has made things tougher so we need more tablets to teach learners and have more content available to them even when they are at home. The subject content is congested using tablets makes it easy for teaching and learning. However we need more devices for learners especially after ours were stolen.

Nare: Has the school made any plans for maintaining or replacing the technology to ensure continuous use of technology at the school? Yes, No

Teacher: The school has communicated with Rural Development about tablets being stolen and have asked for new tablets if possible. The school also encouraged parents to buy tablets for their children since the ICT4E tablets were stolen. The SGB is in the process of fund raising to buy each teacher a laptop. The SGB has started providing teachers with laptops for teaching and learning and their own personal development. The school has committed to buying three laptops per year for teachers as a way of integrating technologies in teaching and learning after the learner tablets were stolen. However the process is slow because of lack of funds.

Nare: What is the impact of mobile technology use and integration on the process of teaching and learning?

Teacher: Mobile technology has a positive impact on teaching and learning, learners started coming to school regularly and absenteeism reduced significantly. Mobile technologies motivates learners to learn everywhere, even if they are not in school. Education is everywhere. Tablets make it easier to teach in large classrooms, the teacher is able to focus on those learners that need specialised individual attention while other learners use tablets. The use of technology changes the attitude of both learners and

teachers. Learners' performance and understanding improves drastically. Technology expands learning to the home environment. Learners can access content on tablets even when they are at home. It does not have to be restricted to the classroom.

Nare: Why is it important to use and integrate mobile technologies in teaching and learning?

Teacher: It is important to use mobile technologies in teaching and learning because learners come to school more and they have access to more content on the tablets. Technology makes lessons more understandable and interesting because learners are able to research more on their learning areas. Tablets makes learning easier because learners learn more easily when they can play and touch objects like tablets and this tends to help them remember lessons better. Tablets improves the cognitive development of learners rapidly.

Nare: How can mobile technologies be used and integrated in teaching and learning?

Teacher: Mobile technologies accelerates the process of evaluating leaning results and gives students and teachers the opportunity to track progress quickly. Technology should be used in all learning areas not just for NS and Technology. This will ensure that learners have access to more content on the internet using the technologies for learning and teachers can also benefit because lessons will be more understandable as learners are exposed to a bigger content on the internet. The educator will use an overhead projector to demonstrate whatever they are teaching then give learners work to use their tablets. So we need more than tablets to fully integrate technology in teaching and learning. WE should download apps that are relevant for teaching all learning areas in schools to make it easier to integrate mobile technologies in the process of teaching and learning. WE need more content for the secondary phase to do projects and investigations for subjects like creative arts and technology subject. It has to be used by everyone in the school for the different learning areas and school subjects for research, downloading material for teaching and learning. Provide all teachers with mobile technologies for classroom teaching and for learners for research and writing exams. Give schools more tablets that are enough for all learners.