

**THE PEDAGOGICAL IMPACT OF SMART CLASSROOMS ON TEACHING AND
LEARNING OF GRADE 11 IN THE TSHWANE SOUTH DISTRICT**

BY

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DECLARATION

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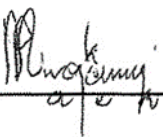
THE PEDAGOGICAL IMPACT OF SMART CLASSROOMS ON TEACHING AND LEARNING OF GRADE 11 IN THE TSHWANE SOUTH DISTRICT

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DEDICATION

This study is dedicated to my father, Stanley K. Mugani, as well as to my beloved mother, Scolastica C. Mugani, who is a source of inspiration and motivation in my academic journey as she strived throughout my education journey. I love you, mama.

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ABSTRACT

The study investigated the pedagogical impact of the use of smart classrooms by Grade 11 secondary teachers to facilitate the teaching and learning in the Tshwane South District. The lens used to understand this study's problem was Technological, Pedagogical and Content Knowledge. The researcher used the interpretivist paradigm and a qualitative approach was applied. A multiple case study research design was also employed. Five secondary schools were used from which to collect data. The instruments used to collect data were semi-structured interviews, non-participant observation and document analysis.

The population comprised Grade 11 secondary teachers. The ten participants were purposively sampled on basis that they taught Grade 11 classes using smart classrooms on daily basis. Ethical considerations were maintained by ensuring anonymity, voluntary participation, informed consent and confidentiality.

Data collected were analysed using thematic analysis. The data were coded and organised into descriptive themes. Trustworthiness in the study was maintained through credibility and transferability. The results revealed that the introduction of smart classroom have a predominantly positive impact on the pedagogy in education and teachers are enjoying the new era in education. The findings of the individual semi-structured interviews reflect that the participants of this study used smart technology in their daily teaching. The findings also revealed that smart technology is useful, important and effective in the teaching and learning process. The findings of the non-participant observation revealed that participants showed varied degrees of mastery of Technological knowledge, Technological Content Knowledge and Technological Pedagogical Knowledge. Some participants were well conversant with navigation of the smart board. They could use the tools and icons on the smart board throughout the lessons. The findings of the document analysis revealed that the five schools had an ICT file and the table of contents of these files were spelt out clearly. Every school had a policy on ICT integration and implementation.

KEY TERMS: impact, pedagogy, smart classroom, smart board, smart technology, technology integration, secondary school teachers, teaching and learning

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ACRONYMS

AAP	Annual Assessment Plan
ANA	Annual National Assessment
BBT	Born Before Technology
BYOD	Bring your own device
CAPS	Curriculum Assessment Policy Statement
CAT	Computer Application Technology
CES	Consumer Electronics Show
CESI	Computers in Education Society of Ireland
CK	Content Knowledge
DoE	Department of Education
DVD	Digital Versatile Disk
GDE	Gauteng Department of Education
GOL	Gauteng online
HoD	Head of Department
ICT	Information Communication Technology
INTO	Irish National Teachers' Organisation
IT	Information Technology
IWB	Interactive White Board
LCD	Liquid crystal display
MEC	Member of the Executive Council
MGSLG	Matthew Goniwe School of Leadership and Governance
PC	Personal Computer
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
SA	South Africa
SGB	School Governing Body
SMART	Specific Measurable Achievable Realistic and Timely
SMT	School Management Team
TCK	Technological Content Knowledge
TK	Technological Knowledge
TPACK	Technological Pedagogical and Content Knowledge

TPK	Technological Pedagogical Knowledge
UNISA	University of South Africa
USA	United States of America
VCR	Video Cassette Recorder

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CHAPTER 1: THE INTRODUCTION AND PURPOSE OF THE STUDY

1.1 INTRODUCTION

Chapter 1 gives an overview of the entire study which seeks to investigate the pedagogical impact of smart classrooms on teaching and learning of Grade 11 in the Tshwane South District in South Africa. The major components of the chapter include a background of the study, the rationale of this study, the methodology and theory of the study, the statement of the problem, the research question and sub-questions, the aims of the study, the assumptions of the study, the definition of key terms and the research outline.

1.2 BACKGROUND OF THE STUDY

The 21st century is characterised by technological inventions and discoveries seen in all aspects of life, particularly in education (Foradian, 2013). Information and Communication Technology (ICT) have improved and continued to change. These changes are visible in schools all over the world. The use of technology creates a conducive environment for learning which promotes self-confidence and creativity in learners. Governments and educational institutions value the inclusion of technology such as smart classrooms in schools, and it is now a vital tool in teaching and learning (Nwigbo & Madhu, 2016).

Smart classrooms are classrooms equipped with electronic smart devices such as laptops, smart boards, smart phones and smart televisions (Das, 2016). Smart classrooms in Gauteng have smart boards that replace the traditional chalkboards and each learner has a tablet. The internet and data projector are other multimedia devices that are used in these smart classrooms. Smart classrooms help in the preparation and organisation of classroom activities and reduce information barriers by bringing new knowledge closer to the teachers as well as to the learners. It is in this view that led to the introduction of the smart classroom in selected schools in Gauteng Province by the Member of the Executive Council (MEC), Honourable Panyaza Lesufi.

In the MEC's five-year plan of 2014 on education in Gauteng, he included the following,

Improving performance of township schools, improving the quality of education – Grade 12 pass rate 90%, increase bachelor passes and improve Annual National

Assessment (ANA) performance (75% of learners achieving the required performance), Improve performance in mathematics and science through the use of ICT. Building the classroom of the future, connectivity in each classroom, create an information hub, ensure infrastructure, equipment and support to schools, smart classrooms with access to computers and broadband internet can improve teaching and learning at schools. (Lesufi, 2014: Gauteng Department of Education [GDE], 2014: 3-6).

The above dream came true when smart classrooms fitted with electronic smart boards, were constructed for non-fee-paying schools in Gauteng province. In 2015, the MEC for Education in Gauteng Province introduced paperless classrooms called 'smart classrooms' in township schools in Gauteng province in a bid to ameliorate the education system in the province. In the Tshwane South District, the townships that received smart classrooms included Atteridgeville, Mamelodi, Olievenhoutbosch and Soshanguve. New touch screens called smart boards, which teachers used in their daily teaching and learning process, replaced chalkboards. Laptops and tablets were given to principals, teachers, and learners to use in learning as well as teaching in schools. Classrooms were renovated to become smart classrooms with advanced technology and access to the internet. In 2017, the GDE escalated the project to fee-paying schools to improve the standard of education in the district. These smart classrooms are secured with steel burglar bars and steel doors to prevent the new technology from theft.

The introduction of smart classrooms led me to undertake this study that seeks to investigate the pedagogical impact of smart classrooms on teaching and learning of Grade 11 in the Tshwane South District, and how teachers use it to facilitate the processes of teaching and learning.

1.3 THE RATIONALE FOR THE STUDY

The use of technology has spread to all sectors of the economy such as education, among others, where it is being used for everyday activities in supporting teaching and learning. The use of electronic gadgets in learning and teaching is now the order of the day in many schools. It is a growing influence in many educational institutions in developed countries and it is being used in many countries worldwide.

The launch of the smart classrooms was welcomed by learners, teachers, principals, and the community at large (Javan, 2015). If effectively implemented, this can take the education of the country to greater heights and improve results. It can assist in producing competent learners that have technological skills that can be used anywhere in the world. Recent studies show that the successful installation of technological devices in classrooms for instruction, not only improve learners' test scores, but also promote learners' individual freedom and develop teachers' technological skills (Bates, 2014).

Today, people require the use of innovative systems and technological devices in many aspects of daily life. We now depend on and are often addicted to the use of technology. These technological devices are being used more often during the process of teaching and learning by both learners and teachers, (Cox, 2019). Advancement, inventions and developments in science and technology have resulted in recent innovations becoming part of the learning and teaching process in smart classrooms. Technology is of great importance in giving education to learners that will provide them with the skills and knowledge required for the world of work. In the job market, few jobs do not need the use of 21st century technological skills (Ramey, 2013). These are skills that prepare learners to be effective workers, leaders and citizens in the new digital global world, and include creativity and innovation, communication and collaboration, as well as critical thinking and problem-solving (Gunter & Gunter, 2012). All these skills are acquired through the incorporation of technology into the instructing and learning process as it changes how we work, learn and live. The use of technology encourages teamwork and enhances interactive relationships between learners and teachers (European School net, 2014).

For technology to be consistently used in schools, it must be designed in a continuous manner. It must be developed taking into consideration the fact that it will also be used in the future. The accomplishment of these developments lies in their ability to be sustainable (Kafyulilo, 2014). For sustainable and effective implementation of the smart classroom in teaching and learning, it needs well-planned teachers' professional training and development. Teachers must be well trained and alerted to new challenges to come.

The utilisation of such technological devices in schools has been tried and tested in African countries' education system such as Tanzania, as described by Kihwele and Bali (2013). Unfortunately, it failed due to lack of availability of resources, beliefs, as well as lack of skills and resistance to new systems and a problem with electricity supply. This is also evident in the South African situation as some parents and teachers have negative attitudes due to moral values (Segalo & Rambuda, 2018), and there are problems with bandwidth and sometimes intermittent electricity supplies.

Some problems faced by people when using these smart devices are discussed below. From the early days of their introduction into schools, smart classrooms were rolled out to non-fee-paying schools in townships, (South African Government News Agency, 2016), where most learners come from informal settlements without proper electricity supply. Although the charging of mobile devices is possible by using generators and solar power, a continuous supply of power is needed for electronic gadgets and computers to work.

Another problem that we face with the introduction of new technology like the smart classroom is lack of aptitude. Teachers are not well prepared to adapt to the changes and are not equipped with the necessary skills required for effective use of technology, (Barrett, Gardner, Joubert, & Tikly, 2019). Another view on the aspect of digital competence was expressed by (Howard, 2013), who commented that teachers' resistance to the use of technology was naïve as they felt inferior because they were born before technology (BBT), which results in resistance to adopting new technological systems.

1.4 STATEMENT OF THE PROBLEM

The White Paper on e-Education in South Africa calls for schools to improve teaching and learning systems as well as to improve the curriculum delivery using technology in the classroom (Department of Education (DoE), 2007). Gauteng province is one of the provinces that has previously met these requirements through the implementation of Gauteng Online project (GDE, 2014). Teachers have smart board technology in their classrooms; they have laptops meant for preparing and planning their work, but many teachers are not using the gadgets for the core purpose they are prescribed for. Learners have tablets to use for researching and studying. Are they using these devices effectively and sufficiently to achieve planned goals?

As a Computer Application Technology (CAT) and Mathematics teacher who is now using the smart classroom technology in teaching and learning compared to the traditional methods of teaching, as well as being an ICT coordinator at our school, my concern about the new technology introduced in the schools and the way in which it will change teaching and learning in schools was aroused.

This investigation examines how Grade 11 teachers use smart boards in teaching and learning, and the impact of smart classrooms on teaching and learning in secondary schools in Pretoria. This was to determine whether the systems are being implemented effectively in selected schools and what mechanisms are in place to ensure effective usage of the facilities.

In addition, the researcher examined whether the system was or was not improving the pedagogy of the teachers and to explore whether users are fully trained to use the new technology and to explore whether users are fully trained to use the new technology.

1.5 THE RESEARCH QUESTION

1.5.1 Research Question

In view of the above, the research or main question of this study was:

What are the pedagogical impacts of smart classrooms to Grade 11 secondary school teachers in teaching and learning in the Tshwane South District?

1.5.2 Sub-Questions

To help in addressing the research question, the following sub-questions emanated to help to investigate the pedagogical impact of smart classrooms in teaching and learning.

- How do Grade 11 secondary school teachers in Tshwane South District use smart classrooms to enhance their teaching and learning?
- What support do the Grade 11 secondary school teachers receive concerning the use of these smart classrooms?

- What are the challenges faced by Grade 11 secondary school teachers when using smart classrooms for teaching and learning in selected secondary schools in Tshwane South District?

1.6 PURPOSE, AIMS AND THE OBJECTIVES OF THE STUDY

1.6.1 The Aim

This study sought to investigate the pedagogical impact of smart classrooms in teaching and learning of Grade 11 in the Tshwane South District in Gauteng Province of South Africa.

1.6.2 Objectives

- To explore how Grade 11 teachers, use smart classrooms in teaching and learning at selected secondary schools in Tshwane South District.
- To determine the support Grade 11 secondary school teachers received with regard to the use of smart classrooms.
- To identify challenges faced by Grade 11 teachers when using smart classrooms for teaching and learning in selected secondary schools in Tshwane South District.

1.7 ASSUMPTIONS OF THE STUDY

It is assumed that:

- The selected schools use smart classrooms.
- Teachers are using smart technology in their daily teaching.
- These teachers are experienced, skilful and knowledgeable in teaching using smart technology.

1.8 RESEARCH METHOD AND DESIGN

The researcher planned the entire study around the interpretivist paradigm approach. In this study, the researcher intended to investigate and have a better understanding of human actions and opinions as they incorporate smart technology in their teaching. People originate the meaning of the world through engagement and interaction with given situations. Interpretive research suggests that interpretations are not the same

as they are meant to suit the desire of the one who created them and to whom they are addressed and are objective or subjective (Creswell 2014).

Methodology is the compilation of methods or guiding principles, by which a research is conducted (McMillan & Schumacher, 2014). It comprises the following principles, theories and values that are suggested while being directed by the approach to research (Somekh & Lewin, 2011). Rajasekar, Philominathan and Chinnathambi (2013) state that a study methodology is a standardised conduit with complicatedness solving and defining how the research is to be done sometimes called the work plan, support these observations. This was a plan and possible techniques that the researcher followed when exploring the pedagogical impact of smart classrooms, on the learning process, at selected secondary schools in the Tshwane District in Pretoria.

McMillan and Schumacher (2014) described a research design as an action plan for investigation used to collect data, to provide and harness evidence as well as respond to the research questions. This includes how the researcher gathers data and the instruments used, how these tools will be used and the way in which the collected data are sorted. A case study design that used a multiple case study type was selected for this investigation.

Zimmerman (2016) describes a case study as the study of an issue, using one or more cases in a bounded system, with the aim of gaining an in-depth understanding of each case in the study. In this study, the pedagogical impact of smart classrooms on teaching and learning in Grade 11 in the Tshwane South District is the issue being investigated. The multiple case studies were five sampled secondary schools using smart classrooms.

A case study is a qualitative technique where the researcher uses numerous forms of information that consist of observations, interviews, documents and reports that examine cases or situations happening over a period (Creswell, 2014). In this study, this approach is used, as the researcher investigated Grade 11 secondary school teachers' lived experiences in using smart classrooms.

The qualitative approach was preferred for this study because it was appropriate on the principle that reality is pinned on relations and experiences of individuals in their

environments (Glosne, 2011). Selected secondary school teachers were fit for this study due to their interaction and daily experiences with smart classrooms in a natural setting. The researcher brought into play this approach in this study to collect data in order to come out with a detailed understanding of the pedagogical impact of smart classrooms in teaching and learning currently used in their schools.

1.8.1 Population and Sampling

McMillan and Schumacher (2014) define the population as the sum of a group where results from a research can be generalised while the sampling is a group of individuals who are taken as part of the study from whom data is retrieved. Sampling is a decision that the researcher makes in relation to, where the data will be gathered from, and from whom the data will be gathered, (McMillan & Schumacher, 2014). For this study the researcher requested ten secondary school teachers from five schools in the Tshwane South District, where smart classrooms are used in teaching and learning to volunteer participation in the study.

According to Creswell (2014), the most suitable qualitative sampling is the purposeful sampling, where the investigator personally request persons who comprehend the principal phenomenon to participate in the study. Purposive sampling, as asserts by Given (2014), is when the researcher selects the participants to be included in the sample on the foundation strength of their understanding of the phenomenon under scrutiny.

In this study, the preferred method purposive sampling involved some unique characteristic and were specific requisite of the participant. They ought to have some understanding in smart classrooms that has to be considered in choosing the sample, targeting Grade 11 teachers. Two teachers per school, where smart classrooms are used in day-to-day teaching, were requested to volunteer in the study. Entrenched in this, was the idea that unlike other forms of research where people are viewed as interchangeable, in this particular research they are distinctive.

1.8.2 Data Collection Methods

Data collection is a well-structured plan that covers the specific techniques of data gathering for an investigation (Maree, 2013). The qualitative data-collection

instruments that were deployed to collect qualitative data were semi-structured interviews, document review and non-participant observations.

Semi-structured interviews were used because they provided the researcher with more control over the topics of the interview as a series of predetermined open-ended questions were asked. Semi-structured interviews gave the researcher more control over the subject under discussion as the respondents were free to answer as they wished.

Document analysis was also used. Maree (2013) mentions that documents such as lesson plans or policy documents can be used to collect data. The researcher looked at several documents to provide a greater understanding of the phenomenon being studied. The researcher read and studied the ICT policy files at each school to check if they included policy documents on smart classrooms, annual teaching plans, work schedules and lesson plans because these documents are used in the process of teaching and learning.

Observation is another way of gathering information where the researcher personally observes a phenomenon in its naturalistic environment without influencing it (McMillan & Schumacher, 2014). Observations are normally done by people who are not part of the system and are used to authenticate and enhance information gathered (Maree, 2013). Observations can result in extra information being gleaned under natural conditions. In this study, the researcher observed Grade 11 lessons where teachers used smart classrooms. The researcher used a checklist as a non-participant observer.

1.8.3 Data Analysis and Interpretation

Data analysis involves scrutinising the data collected and grouping it together into categories of information that help to address the research questions (Creswell, 2014). Taking cognisance of this, the researcher was guided by initial concepts and developed an understanding that shifted and changed while collecting and analysing the data.

As explained by Marshall and Rossman (2013), data analysis procedure is a six-step process that includes:

- 1) Grouping of data
- 2) Understanding of data
- 3) Categorising and giving themes
- 4) Coding of data
- 5) Data interpretation
- 6) Searching for the alternative to promote further understanding

Hoonard and Hoonard (2012) also support this idea in stating that all data analysis procedures must help in developing concepts and when confirming already existing concepts. From the foregoing, one should be able to come up with a picture of how the inclusion of smart classrooms is faring within education in Pretoria. The researcher used Marshall and Rossman's data analysis procedure.

1.9 MEASURES TO ENSURE THE TRUSTWORTHINESS OF THE STUDY

Bless and Higson-Smith (2013) assert that trustworthiness in qualitative research refers to how much trust or faith people have in your research process and the findings. Some of the identified measures to ensure trustworthiness and high quality are credibility, dependability, transferability and conformability (Babbie & Mouton, 2013; Bless & Higson-Smith, 2013). The researcher strived to achieve high trustworthiness through applying two principles, namely, credibility and transferability.

1.10 ETHICAL CONSIDERATIONS

Ethics in research are the standards of good behaviour that a specific study follows (Ramorola, 2010). Ethical guidelines are followed to guarantee that participants in research tasks are shielded from damage and are not misled. Rossman and Rallis (2003) clarify the accompanying moral issues: It is important to take into consideration the ethical issues for the benefit of participants (Creswell, 2014). Regardless of the research site, design and objectives, the researcher carefully examined the potential impact of their research on the experiences of the participants.

1.11 LIMITATIONS AND DELIMITATIONS OF THIS STUDY

1.11.1 Limitations of the Study

According to Maree (2014), limitations are factors like time and accessibility of the participants, over which the researcher has no control but which could affect the

research. Limitations may have an impact on the interpretations of findings or lead to misinterpretation of the investigation. Some of the major limitations in this study were that some participants were unwilling to disclose information or put off the interviews which affected the time taken to complete the research. However, dependable and correct data need to be available for effective analysis. The researcher could not control the attitudes and perceptions of respondents. The researcher encouraged the participants to be truthful and promised them anonymity.

1.11.2 Delimitations of the Study

This research was confined to public secondary schools using smart classrooms in the Tshwane South District. In spite of the above, efforts were taken to make certain that proper sampling techniques were applied to acquire the information needed to conclude the study. Teachers teaching Grade 11 learners were preferred in this research as the key participants, as they were the primary source of information to address the research questions.

1.12 DEFINITION OF THE KEY TERMS

- *Learning environment* refers to the natural place where actual learning takes place (Das, 2016).
- *Pedagogy* refers to the methods and principles of teaching and learning. Pedagogy is the discipline that deals with the theory and practice of teaching or the science of teaching methods and techniques taking into consideration theories of learning (Yilmaz, 2014).
- *LCD* means Liquid crystal display (LCD). This relates to projectors that are used to display images to the class on a big flat screen or monitor that projects images or it is an output device (Sahu, 2014).
- *Smart* is described as Showing, Manageable, Accessible, Real-time Interactive and Testing (Das, 2016).
- *Smart learning environments*, an environment where learning takes place with the aid of smart technological devices such as Laptops, smart boards, smart phones, smart televisions (Das, 2016).
- *Smart Classroom* is a modern classroom equipped with electronic smart devices (Sahu, 2014).

- *Smart board* is a touch-sensitive LCD, which has computer applications and storage facilities installed on it and replacing the traditional chalkboard (Sahu, 2014). It can be linked to the internet.
- *Technology integration* means the introduction and incorporation of technological devices and resources into day-to-day practices in the classroom (Sahu, 2014).
- *Technology-rich classroom* is a classroom equipped with a variety of technological components such as an LCD projector, a scanner, an interactive whiteboard, and a classroom response system (Sahu, 2014).
- *E-Learning* is a term that refers to the use of ICTs in the teaching and learning process in the classroom (GDE,2011)
- *Digital literacy* is to the ability to use as well as to appreciate the potential of ICTs in supporting the teaching and learning processes. Teachers need to have the confidence, skills and knowledge to apply ICTs effectively in class, (GDE,2011)
- *Internet* is a global network system of interconnected networks designed to serve billions of users worldwide with a variety of documents, resources and services. Nowadays, it is the fastest and widely used mode of communication as emails and social media use internet, (GDE,2011)
- *Real-time interactive dimension*. The smart classroom provides the opportunity for human and computer interaction (Das, 2016).
- *Digital resources* are devices or equipment that are electronic for computing that is, they are used to process, transit , display and store processed electronic data (GDE,2011)

1.13 CONCLUSION AND RESEARCH OUTLINE

Chapter 1 identified the phenomenon that this study seeks to address and explore, and the background of the study was discussed. The rationale of the investigation was articulated. The researcher identified the statement of the problem which led to the identification of the research question that seeks to investigate the pedagogical impact of smart classrooms used by teachers in teaching and learning of Grade 11 in the Tshwane South District. Sub-questions emanated from the main question. The aim and objectives of the study were given in this chapter. The research paradigm and the methodology were briefly explored, which included a discussion of the population, sampling and data collection methods. A brief discussion of data analysis and

interpretation was done in this chapter. Measures to ensure the trustworthiness of the study, ethical considerations, limitations and delimitations of the study were discussed and the key terms were defined.

Chapter 2 presents other authors' opinions on the use of the smart classroom and its implications for teaching and learning. The related literature on the pedagogical impact of smart classrooms in teaching and learning is discussed. The introduction and impact of smart classrooms in other countries where smart technology was implemented before being introduced in South Africa is also examined in chapter two. TPACK is the theoretical framework on which the study is based. The chapter ends with an analysis of the benefits and challenges faced by teachers when using the smart classroom.

Chapter 3 explores the methodology that was engaged when conducting this study. The researcher details the paradigmatic perspective, the research methodology and the research design and provides justifications for the sampling techniques that were followed when selecting the population and samples for the study. The techniques and procedures used to collect and analyse the data of the study are discussed in this chapter. At the end of the chapter, measures to ensure trustworthiness and ethical considerations that were applied during the study are examined.

Chapter 4 discusses the methods of data collection, data presentation, data analysis and discussion of findings. Ten teachers were selected. Two participants from each of the five participating secondary schools were interviewed using individual semi-structured interview questions (Appendix A) from which themes emerged. Non-participant observation was done in each participant's classroom using a checklist (Appendix B) and a document analysis of the ICT files was conducted using a check list (Appendix C). The themes that emerged from the data gathered and analysed are also discussed. The findings in Chapter 4 provide an understanding of the pedagogical impact of smart classrooms on teaching and learning of Grade 11 in the Tshwane South District.

Chapter 5 gives a summary of the findings of the investigation. The researcher addresses the limitations of the investigation and provides reflections on them, followed by the conclusions based on the research objectives. The researcher makes

some broad proposals and recommendations arising from the findings and makes recommendations for future investigations.

The next chapter provides a review of the literature related to the use of smart technologies in education.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Technology integration means using technological gadgets such as smart boards, projectors, smartphones, tablets, digital cameras, computers and application software as well as the internet in the daily teaching and learning process. Effective integration is achieved when these gadgets are used daily in the teaching and learning process to achieve better results, thus improving the standard of education (Drossel, Eickelmann & Gerick, 2017). In the modern world, technology has become the core of all the activities that people do on a daily basis. This means that technology should be used in the education sector to improve the standard of education and the pedagogy (Mustafa, 2014).

The evolution of technology has led to the development of smart technology that is now being used in the modern classroom (Kalanda, 2012). The inclusion of technology in the classroom has encouraged many researchers to carry out research on the impact and benefit of the inclusion of technology in the classroom (Muyambi, 2016). Although these views may differ in some respects, these innovations and developments in technology have also resulted in the development of pedagogical approaches in the classroom.

In this chapter, the views of other scholars about the use of smart classroom in teaching and learning are presented. The related literature on the pedagogical impact of smart classrooms in teaching and learning is discussed. The research is based on Technological Pedagogical and Content Knowledge (TPACK) theory developed by Koehler and Mishra (2006). This theory assisted the researcher to delve into the pedagogical effects of smart classrooms on teaching and learning in secondary schools in the Tshwane South District. TPACK helped the researcher to determine the requirements to effectively incorporate and implement smart classrooms in the teaching and learning process in the selected secondary schools. Furthermore, legal frameworks in South Africa and internationally were explored.

2.2 THE TECHNOLOGICAL REVOLUTION

Use of technology has spread to all sectors of the economy in the likes of education, and industry, where it is being used for day-to-day activities in supporting teaching and learning and industrial operations as the present era goes electronic (Kalanda, 2012). Kalanda (2012) furthermore stated that, the addition of ICT in education is regarded as the utilisation of electrical gadgets in the classroom. It is seen as a growing influence in almost every educational institution in developed countries and it is now being implemented in many countries worldwide. Its origin can be traced to the beginning of the 20th century. This is supported by Nwigbo and Madhu (2016) who indicate that the 1900s marked the beginning of the use of technological devices following the Industrial Revolution. Access and usage of the internet in communication started in the 1960s (Coetzee & Eksteen, 2011). This led teachers to be more interested in embracing the introduction and utilisation of electronic devices to enhance the teaching process.

Gros (2016) also mentions that the development of technology started around 1900s in education where it was used for teaching and learning in distance education and it helped to access valuable and information to foster growth of knowledge. The introduction of smart classrooms brought in the idea that the context and place where teaching and learning occurs is vital as the use of technology gives users the opportunity to experiment with and control aspects of real-life situations and environments in the classrooms (Gros, 2016).

In the 1970s, technology in the form of multi-media such as overhead projectors and film began to be used in the classroom (Bates, 2014). Media were used to assist teachers when explaining concepts during teaching and learning and to supplement the instructional setup to achieve general academic requirements. This led to developments in ICT and the use of personal computers in classroom activities began in the 1980s (Gros, 2016). This was used for lesson preparation, planning and delivery. Now, teachers can use laptops to do research, find useful materials for their lessons, and do their lesson plans and preparations at home. The above can be transferred to smart boards for use during lesson presentations at school.

The origin of smart classes can be traced from 1986. Das (2016) states that David Martin and Nancy Knowlton were the pioneers of the technology. The following year,

1987, marked the beginning of smart technology promoted and marketed by an organisation from Canada. There was income created through the sales of projectors. This income was used for the innovative work of the development of smartboard's intuitive whiteboard, that meant that documents and images produced on a personal computer could be projected onto a whiteboard (Das, 2016). Later, the 1990s marked improvements and major changes, such as the use of ICT being assimilated into instructional technology in education (Gros, 2016). The development of the internet resulted in the use of technology in distance learning as well as the birth of interactive whiteboards with the smart board recently replacing these (Dewey, 2014).

According to Das (2016), in 2004, EDUCOM started using the smart classroom in India in private schools. It has been now included in many public schools and has led to a massive penetration of technology into classrooms in India (Das, 2016). Currently, developing countries are implementing smart classes in their schools to improve teaching and learning.

2.2.1 Smart Technology

The acronym SMART stands for, *Self-Monitoring Analysis and Reporting Technology* (Petra.com, 2018). Petra com (2018) contend that smart technology has the ability to offer people more interaction as well as the control of such devices through the aid of internet. Smart devices such as the Smart board has brought a new technological element to the classroom through the visual element when learning materials can be shown to learners and the ability of gadgets to be used as a resource to access information (Das, 2016). Maheshwari (2017) adds that the smart classroom must be an information source during teaching and learning activities, and all resources can be stored on the smart board for easy accessibility. Smart boards also help in data analysis and recording the interactive processes (Foradian, 2013). The author went on to say, the ability of the smart classroom to show a physical environment in its natural state, colour and clear physical appearance; for example, a volcano erupting becomes easy to understand when using a smart board (Foradian, 2013).

Our lives today have become driven by technological activities, systems and tools. This is obviously true

as the use of technological devices or gadgets has become the daily way of life. We now depend on and may even be addicted to technology, (Stephenson, 2017). Kafyulilo (2014) emphasises that learners use technological devices during the process of teaching and learning without the help of teachers. Advancement, inventions and developments in science have resulted in recent innovations in technology and have become part of the learning procedure in smart classrooms (Menon, 2015). It is of great importance in educating learners that they are given the skills and knowledge required for the world of work. In the job market, few jobs do not need the use of technological skills. All these skills can be executed through the incorporation of technology in all the elements of teaching and learning processes as they change how we work, learn and live. The use of technology encourages teamwork and enhances interactive relationships between learners and teachers (European School net, 2014).

For technology to be significantly implemented in schools, it must be designed in a sustainable manner taking into consideration the fact that it will also be used in the future (Kafyulilo, 2014). For sustainable and effective implementation of a smart classroom in teaching and learning, it must be assisted by well-planned teachers' professional development (Tondeur, Forkosh-Baruch, Prestridge, Albion & Edirisinghe, 2016). Teachers must be well trained and alerted to new challenges to come.

2.2.2 Smart Classrooms

The smart classroom is a revolutionary classroom technology enhanced for teaching and learning equipped with electronic smart devices such as smart phones, smart televisions and smart boards (Menon, 2015). In a smart classroom, a teacher uses a smart board and electronic devices when teaching. With internet connectivity, the classroom becomes more real as it will be connected to the global world. Sahu (2014) defines a smart classroom as a classroom equipped with a variety of technological components such as an interactive board or screen, a projector and a camera. During the lesson delivery, there is more use of technological devices by the teacher and the learners in all lesson activities and demonstrations (Lukaš, 2014). In this classroom, there is less use of paper by both the teacher and the learner.

According to Das (2016), smart classrooms are electronically improved lecture theatres and classrooms. Smart classrooms encourage and open doors for educating and learning by coordinating learning innovation, for example, PCs, specific programming, gathering of people's reactions, innovation, assistive listening gadgets, systems administration and sound/visual capabilities (Das, 2016). In a smart classroom, learners have e-books loaded on their tablets, replacing the textbooks and teachers have laptops with e-books as well.

The introduction of the smart classroom is an innovative and modern idea where the use of electronic devices provides ideal, intelligent, advantageous access to learning. It is also useful for logical mindfulness, classroom management and administration (Forbes, 2017). Smart boards fitted in these classrooms are modern computerised boards that can perform tasks like that of a computer. Subject content is loaded on it and retrieved during lesson delivery. Accessibility and availability of the internet can make it more resourceful for teachers to use.

2.2.3 Smart Boards

A smart board is a modern technological and electrical device used to replace the traditional chalkboard in a modern classroom. Sahu (2014) defines a smart board as a touch-sensitive LCD device that has computer applications, internet and storage capabilities, and it functions like a computer. Smart boards are replacing the use of the traditional chalkboard. On a smart board, a person can write, draw, calculate and colour just the same as on a chalkboard. Work done can be saved for future use. You can record audio and visual lessons that can be presented on a future date. The smart board has e-books installed on it to replace textbooks.

A smart classroom is a concoction of technological electric tools used by in the learning activities and promotes a natural-conducive technological environment applicable in education (Block, Cleary, Fairfield, Henderson, Kuk, Perschall & Ramalingam, 2015). These smart classrooms are computerised classrooms suitable for a contemporary pedagogy, the method that includes the element of "Show me the concept and I grasp" to the classroom as suggested by Edsys (2016). This invention is changing the teacher's methodology and how learners learn in class. Smart devices are attractive teaching tools and appealing to learners as they have an audio-visual component (Edsys, 2016). This improves effective participation and communication among

learners as they interact with these technological tools. The technological tools deemed important for revamping learning opportunities in smart classrooms in Gauteng are described below.



Figure 2.1: A smart board

Source: Smart Technologies (2013)

Smart Board technology (replacing the traditional chalkboard) provides a synergistic and appealing platform that promotes teaching and learning. This board is electrical and looks like a television set, but it is bigger than most of the televisions in our homes. You write on the surface of the smart board with a stylus pen the way we used to do on a chalk board with chalks. If combined with a projector, it allows the user to explore all the computer applications and when connected to the internet, it helps the user to access information from across the globe. Furthermore, users can write, draw, colour, insert objects and save the work on the smart board. The size of smart boards mounted in schools is big enough for learners to see what is being presented to them in full colour (SMART Technologies, 2013).

Learners like using interactive screens (Huang, Spector & Yang, 2019). This is because it presents reality in three-dimensions and this arouses learners' appetite to learn. The presentations can use both 2D and 3D approaches, designs, sound and

video introductions for each subject and provide realistic portrayals of situations from everyday life (Edsys, 2016). Smart boards have various names like the intuitive board, the electronic board and the intelligent whiteboard (Şen & Ağır, 2014), but for this investigation, the researcher uses the term smart board.

2.2.3.1 Functions of smart boards

Smart boards have the same functions of a personal computer. It is an electrical screen or board that has the following functions as prescribed by Şen and Ağır (2014)

- *The touch Function: The touch Function:* Smart boards have touch screen just like some of our phones and monitors. The screen of the smart board works the same as the smart phone where you touch with your fingers and it senses. You can open or close can open and close programs or application by swiping fingers on the screen. One can enlarge or reduce objects or pictures by dragging out or in. Beside fingers, you can connect and use a mouse. The user can open the browser by tapping with the finger on the icon for internet and type the web address or search term and get connected (SMART Technologies,2019).
- *Writing and erasing.* The user can write on a smart board using a stylus pen the same way as people who write on papers. The user moves a pen on the screen. The board comes with an application smart notebook that works almost the same as word application program on a computer. The smart notebook allows the user to draw and colour by changing the colour of the pen through tapping on the pen icon that appears on the far-left side of the screen (Smart Technologies, 2019). The use of different colours for highlighting and shading can be used to compare words, to bring variety as well as quality to the pictures. To erase, the user can select the eraser on the screen and erase information on the board.
- *Save, Open and Print Function:* When using the smart board, a user can save documents and files the same way as on the computers. This makes it easier for the user to keep the work for the next lesson. The information can be retrieved from the saved files in the documents in the library, and be printed if the smart board is connected to a printer. The user can upload and save

different software, eBooks, music and videos. The textbooks of various subjects have softcopies that the user can upload on the smart board and use them.

- *Record Play and Playback Function:* A user can capture and record an audio-visual clip saved on the smart board and later replay it for subsequent lessons. When a lesson is delivered, a user can record all the activities of the whole lesson and save them on these smart boards. The smartboard can also play recorded video clips. The recorded videos can be transferred to external storage devices for use in other classes and lessons.
- *Text Conversion Function:* The smart board can convert handwriting text into electronic fonts that can be saved as word document. When writing with a stylus pen, the handwritten text can be converted to typed text by selecting the function for conversion. The board can be programmed in such a way that when a user writes, it automatically converts handwritten to a typed text.
- *Storage Function:* The smart board can store things the way a computer does. It has a hard drive where a user can save work in folders and files with a name that can be easily remembered. Recorded lessons can also be saved and stored on a smart board for future use.
- *Matching items and learning games:* The smart board has games that can be used to teach vocabulary and concepts. It may be complemented with pictures and spaces and the appropriate responses can be pulled into answers. Puzzles and quizzes can be used on the smart board to enliven the lessons.

The smart board as an essential device that can be used to connect every branch of knowledge. Though many developing mechanical apparatuses are used for explicit branches of knowledge, smart screens can be utilised in every branch of knowledge and in different classes. You can link content in one subject to the other when using these smart boards (Şen & Ağır, 2014).

Şen and Ağır (2014) alluded that, for the most part, learners enjoyed applications in the touch interface and that the interactive board helped them to focus in class sessions. Şen and Ağır (2014) found that schools required smart boards due to the following reasons:

- Smart boards promote learners' participation in lessons. Smart boards help the learners to grasp better, expand their thinking on the exercises and keep them engaged.
- They permit the use of audio-visual media and power point presentations.
- They allow educators to use distinctive and diverse teaching techniques or methodologies.

2.2.4 Multimedia Pens/Stylus

The Smart board is supplied with four whisper-tipped pens (green, black, red, and blue) and one eraser when you purchase it. These pens are called Stylus pens.



Figure 2.2: A smart board pen

Source: Smart Technologies (2013)

Since the smart board has replaced the chalk board, the stylus is electrical, has replaced the chalk used to write, draw and colour on the traditional chalk board. To write, you simply have to move the pen on the screen the way the teachers used to write with the chalks. To erase, the opposite side is an eraser, like some of the pencils which come with an eraser and you need to just wipe on the unwanted texts or words, (Edsys, 2016).

2.2.5 Laptop

The use of well-known innovations like computers, laptops or workstations, makes learners feel progressively more confident and surer about their learning. In a computerised classroom, a laptop or workstation acts as the focal framework that stores the data and is far more basic for overseeing exercises. It is a personal

computer, usually called a notebook, which is portable and usable in any location (GDE, 2011).



Figure 2.3: A laptop

Adapted from Smart Technologies (2013)

With the assistance of a projector, pre-loaded exercises can be displayed on a large screen and can be taught effortlessly (Edsys, 2016)

2.2.6 A Projector / Interactive Projector

A projector linked to a PC or workstation can show the substance on a PC's screen on to a whiteboard or a big white painted surface.



Figure 2.4: A projector

Source: Smart Technologies (2013)

The LCD projector, as indicated by Feierman (2018), is used to show clear, and sometimes colourful pictures to the class from a computer, videocassette recorder (VCR), video camera or DVD player. The projector is a compact machine that converts any surface (existing projector screens, whiteboards, or divider surface) into an intelligent surface and can be used to enlarge texts and picture for learners' visibility, (Edsys, 2016).

2.2.7 A Printer

A printer is a critical piece of making bright assignments, reports or artworks and learners are increasingly energetic about observing their work in the entirety of its brilliant magnificence (Edsys, 2016).



Figure 2.5: A printer

Source: Smart Technologies (2013)

Regardless of whether classrooms have progressed to the phase of going totally computerised, despite everything, we cannot manage without a printer.

2.2.8 Educational or Scholarly Software

There are plenty of software programs that help the real scholarly educational modules and syllabus. This software also empowers instructors to streamline the feedback process, mechanise participation, set test timetables and undertake numerous administrative tasks (Edsys, 2016). In the Tshwane South District, smart boards are loaded with e-Books that are aligned to the curriculum being followed. These e-Books are soft copies of the textbooks used by the school and are acquired from textbook publishers.

2.2.9 Tablets

A tablet is needed for each learner in a smart classroom.



Figure 2.6: A tablet

Source: Edsys (2016)

These gadgets are very familiar to learners. They support reading and give learners the opportunity to review their exercises at any time. If connected to the internet, learners can explore the world (Edsys, 2016). E-books, learning material or resources and past exam papers can be loaded onto each tablet. These gadgets also come with a built-in dictionary. If connected to the internet, teachers can form chat groups with learners where they can discuss educational issues. Homework and reminders for examinations and tests can be communicated using the tablets.

2.3 POLICY ON INCLUSION OF TECHNOLOGY IN SCHOOLS

The White Paper on e-Learning (DOE, 2004) in South Africa calls for schools to develop the teaching-learning system so as to improve the curriculum delivery through the utilisation of technological devices in classroom activities. According to this White Paper, access to the continuously changing world can now be provided to learners through the revolutionised digital media that is now being operated in the ICT classroom. The White Paper sets out government's commitment to make sure that all schools have the resources they need to address the diverse needs of learners. This paper also spells out that all sectors must work together to ensure that children get a high-quality education (DOE, 2003).

The e-learning policy goal stipulates that every learner in South Africa must use ICT confidently and acquire knowledge as well as skills to use and be competent in the global world (DOE, 2003). This White Paper further states that all stakeholders (teachers, managers and administrators in education) should have skills and knowledge and they must get the support they may need to incorporate ICT in teaching and learning. Training programmes must be in place for effective implementation of teaching and learning using technology in schools.

The use of ICT in education is an important strategy of the government to improve the standard of training and education in the country. The focus of this policy is on quality teaching and learning for a better future in the modernised digital and technological world. The White Paper mandates the government to promote and generate electronic content that aligned with the changing world.

An action plan has been put in place by the government to ensure the proper implementation of e-learning and an implementation strategy for e-learning in South Africa from 2013-2025. The aims of this strategy are to:

- implement the aims of the White Paper on e-Learning;
- implement the action plan of 2014, sections 16 and 20; and
- Implement the National Strategy on Learner Attainment (DOE, 2004).

The GDE has met these requirements through the implementation of the Gauteng Online project (GDE, 2014). Teachers have smart-board technology in their classrooms, and they have laptops meant for preparing and planning their work. Educators are supposed to use these ICTs in a such a way that it improves teaching and learning. Learners have received tablets to use for researching and studying. The question is whether they are using these devices effectively and sufficiently to achieve planned goals.

The new South African Curriculum and Assessment Policy Statement (CAPS) (Department of Basic Education [DBE], 2011) advocates the development of intellectual skills and strategies in the teaching and learning process using technological devices and the internet. Grayson, Harris, McKenzie and Schreuder (2014) maintain that the CAPS emphasises the use of technology and internet services in the learning and teaching of sciences. Despite the implementation of the strategy, it seems that little has been done to ensure that it is being done properly and there is thus a need to investigate whether learners and teachers can cope with these innovations in education.

The investigation considers how Grade 11 secondary school teachers use smart boards in the teaching and learning process and the extent to which smart classrooms affect teaching in secondary schools in Tshwane South schools. It seeks to investigate whether the systems are being implemented effectively and how the use of smart boards at the sampled schools is impacting teaching and learning.

The next two section discuss the advantages and disadvantages of smart classrooms in education.

2.4 BENEFITS OF USING THE SMART CLASSROOM

On a positive note, the use of technology has brought the following good effects on education and the world at large. In terms of pedagogy, the key factors as proposed by Thorsteinsson (2014) are discussed below.

2.4.1 Teacher Preparation

Lesson preparation has become easier when using smart boards using readily available materials that are on the smart board. The use of the internet is another advantage as teachers can search for already made lesson plans and modify them to suit their needs (Thorsteinsson, 2014). Online information is readily available at teachers' disposal. Teachers can share their lesson preparations and their ideas using the internet, through social media via the smart board (Lumme, 2017).

2.4.2 The Teacher's Role in a Smart Classroom

Some of the roles of a teacher in a smart classroom are now being a facilitator, tutor and administrator. This has changed from being the source of information to using instructional teaching methods to support learners while they work independently (Thorsteinsson, 2014). The teacher will only give instructions to learners and guide them throughout the lesson. Teachers guide the learners and only help if the need arises.

2.4.3 Lesson Interaction and Integration

The use of technology has allowed for more real and actual objects to be used as media in the classroom. This has created an interactive environment where learning takes place in the presence of maps, images, photos and animated videos that promote learning (Thorsteinsson, 2014). The smart board is colourful, thus attracting learners' attention and this leads to more effective individual learning (Foradian, 2013).

Lessons can be linked from one subject to another using programmed lessons saved on the smart board. The use of attractive audio-visual teaching tools appeals to learners and the use of eye-catching visuals can help learners to recall and to relate what they are seeing to the real component or concept, (Foradian, 2013). According to Lumme (2017), the use of smart boards broadens the styles of teaching as they allow for interaction with tools on the board. Lumme (2017) further says that learners

can do their work on their own gadgets and later present the work using the smart board. This is helpful to learners who are shy in class as they can participate in this way. Foradian (2013) suggests that assessments can be made easier using a smart board if clickers are incorporated in the smart board and it has a large storage capacity and voice recording ability

2.4.4 Environmentally Friendly or Go-Green Smart Classrooms

Smart classrooms are the only answer to the traditional classroom that is congested with a lot of paper, handouts and textbooks as well as dust from chalk (Foradian, 2013). Teachers can teach in a smart classroom without the use of pen and paper (Thorsteinsson & Olafsson, 2015). The use of printouts and copies is limited thus reducing damage to the environment. There is no need for the teacher to printout pictures, maps and other diagrams related to your lesson. The teacher can just show the learners. Some learners and teachers suffer allergies caused by dust from chalks and the smart classroom offers an environment that is free from dust (Foradian, 2013).

2.4.5 Connection with the Rest of the World

The use of the internet is a mode of connection with the rest of the world that provides a global education (Forbes, 2017). This allows teachers to participate in a continuously globalised and interconnected world. They can access large volumes of information stored on the internet during class. These resources bring excitement into the classroom (Thorsteinsson, 2014). Learners can search for a country and connect with the people of that country or research that country. A picture can make learners think critical. Forbes (2017) stresses that you can stream live video using the webcam on the smart board where learners can interact in class and globally with other learners in other countries.

2.4.6. Availability of Digital Tools

The presence of digital tools creates a more user-friendly environment. Teaching has become easier using smart classrooms. Lessons can be presented using videos and PowerPoint. The use of CDs, memory sticks and microphones contributes to the learning environment (Foradian, 2013). The digital pen tool makes learning more interesting. Functions like cut, save, drawing tools and other computer actions makes learning easier. You can plan, teach and record a lesson on a smart board and save

it for future use. This has made teachers become more innovative and motivated to teach, as all resources are available at their disposal.

2.4.7 Diversity

Smart boards provide a versatile system to connect classroom practitioners with their learners. The social setting helps to address the diversity of learners (Pourciau, 2014). With learners of different abilities in the same class, lessons presented on the smart board can help everybody to learn. The teacher must cater for learner diversity in his or her class. It is crucial for the teacher to choose teaching methods that benefit all learners. Solvie (2013) states that individual perspectives help to understand the environment.

Teachers should be aware that their attitudes can impact lesson flow. Learners come from many social backgrounds, and it is the teachers' obligation to address every learner's needs with the understanding that everyone can learn (Solvie, 2013). Teachers should be committed to accommodating learner diversity in their classes. Technology is helpful in planning lessons that will address the needs of every learner in the classroom.

Pourciau (2014) states that using technology positively affects learners' results. The use of technological devices during lessons should be done considering the different learners' abilities. This can be a key to employing different strategies to foster understanding of key concepts in learners. The inclusion of a variety of media-rich teaching aids helps to diversify the lessons, (Pourciau, 2014), but it needs guidance and knowledge on proper selection of the necessary device that is suitable for the activity to be done as it may result in more confusion among the users.

2.5 CHALLENGES FACED BY TEACHERS WHEN USING SMART CLASSROOMS

Despite the good things the adoption of technologies in education has brought, there are some significant challenges that hinder widespread and effective implementation of this programme. Many researchers have found the following negative challenges faced when using smart boards.

2.5.1 Professional Development and Training

A major difficulty is the unavailability of proper, continuous professional development of educators who need to implement the use of technology into their lessons yet are badly prepared or do not understand the new technological developments. Nagel (2013) maintains that many teachers lack the technical knowhow to operate the new technology. No proper training is in place for the implementers of the programme. Teachers lack the skills and proper knowledge of how to deliver their lessons using technology. According to Nagel (2013), this leads to underutilisation of the programme or it becomes a white elephant abandoned without anyone to take care of it.

2.5.2 Resistance to Change

Resistance to advancement comes in various ways, yet the major challenge perceived is “comfort with the same old thing” (Nagel, 2013:1). Most teachers lack self-motivation and skills. Most of these teachers are wedded to the chalkboard and cannot let it go. Thus, this will impact negatively on the implementation of smart classrooms.

2.5.3 New Models (Technology) for Educating and Learning

New models are challenging customary models of teaching (Nagel, 2013). New methods like online learning can be a challenge to learners if not properly guided. These models are failing to challenge learners in experiments and other tests (Nagel, 2013). They do not train learners to face challenges, as learner are not able to think independently. Answers are available on the net at their disposal. Therefore, this can influence assessments and examinations.

2.5.4 Technical Support

Another problem with smart boards is they are electronic gadgets, are prone to technical faults and rely on the constant availability of electricity (Foradian, 2013). When the power goes down, for example, with load shedding, this can happen in the middle of a lesson and this may influence the enthusiasm of learners to learn. If it is an electronic fault, the teacher may abandon the lesson while looking for a technician if there is one stationed at the school, (Foradian, 2013).

2.5.5 Cost of Purchase and Maintenance

The cost of purchasing the smart boards is one of the challenges affecting the introduction of these facilities in all schools. According to Foradian (2013), smart boards are expensive and are supplied by only a few service providers. All the gadgets used in a smart classroom such as LCD screens, computers, laptops and projectors come at a high cost. The cost of maintaining these gadgets is another hindering factor as highly trained technician are needed if there are problems. Their services are expensive, and most schools cannot afford this.

Despite all these negative factors, the positive effects are more evident in schools that are using smart technology in their schools. There are more advantages than disadvantages in using smart boards for teaching and learning in schools, (Lumme, 2017).

2.6 SMART CLASSROOMS DEVELOPING IN COUNTRIES

2.6.1 Malaysia

In Malaysia, there has been solid effort to use data innovation broadly in the instructing and learning process, (Peow, 2009). Smart schools were introduced in 1999 and were an endeavour by the government to ensure that all Malaysian schools accelerated innovation in ICT and it has significantly changed the present instruction and learning methodologies, the present school educational programmes, teacher training and the administration of records (Peow, 2009). Due to the enormous subsidy from the government to change schools in Malaysia through innovation, the classrooms are now more determined to use the new technological devices in place of traditional teaching techniques. According to Peow (2009), research showed that Malaysian instructors were overwhelmed by and were satisfied with the customary type of teaching, which depends on reading material, providing notes and using slates. However, numerous interventions have been put in place to reduce reliance on reading material in view of the significant changes in instructive educational programmes in Malaysia.

2.6.2 Mauritius

In Mauritius, the implementation of smart technology in school can be traced from 2008 where interactive white boards (IWB) were introduced (Bahadur & Oogarah, 2013). In 2011, Mauritius become one of the first countries in Africa that introduced IWB at primary school level. This project resulted from the “Sankoré project of 2008, a brainchild of the Franco British Summit of 2008”. Bahadur and Oogarah (2013) state that its main objective was to assist Africa to meet its educational goals by means of digital empowerment. It aimed to usher in improvements in the quality of schools and bring about essential developments in the learning process (Bahadur & Oogarah, 2013).

In addition, Bahadur and Oogarah (2013) state that an in-depth assessment on the advent of IWB as an instrument for teaching as well as a learning tool in schools was conducted. This evaluation aimed at determining the effects of the integration of IWB in schools, the views of teachers on learner performance, educational growth and attitudes. They found that the IWB were effective as they enhanced teaching and learning in the classroom and supported the learning process. The results also show that teachers viewed the IWB as being an adaptable and multifaceted tool for teaching and was user-friendly for everyone who was keen to learn. Bahadur and Oogarah (2013) also say that teachers enjoyed using the IWB as it enhanced professional educational practices and productive lesson presentation.

Furthermore, it reduced disturbances, enhanced detectable quality and reduced the amount of repetition in writing as it allowed them to save work for future use (Bahadur & Oogarah, 2013). The report went on to say that learners enjoyed the versatile and user-friendly properties of these IWB, but this was not applicable to learners who did not want to go to the board and participate. The IWB increased the enthusiasm of learners by making lessons more interesting and entertaining, ensuring additional interest and good behaviour due to its multi-sensory input, and catered for dynamic styles of learning to benefit all the users.

Bahadur and Oogarah (2013) also identified some of the problems associated with using the IWB. These problems were mainly associated with practicalities such as lack of training and adequate technical support that can hinder and exasperate teachers. They added that the location of the IWB in a room, its daylight reflection, dust on

technological devices and users' positions in the classroom could affect or obstruct learning.

2.6.3 Tanzania

The use of technology in the classroom was also tried in Tanzania (Kihwele & Bali, 2013). Unfortunately, it failed due to lack of availability of resources, attitudes and lack of skills, resistance to new systems and the supply of electricity (Kafyulilo, 2014).

2.6.4 South Africa

In South Africa, the introduction of smart classrooms was early in January 2015 and one of the pilot schools was a non-fee-paying Secondary School, Boitumelong in Tembisa, Gauteng Province (Patel, 2018). The introduction of smart classes was an implementation of the Gauteng Education MEC Panyaza Lesufi in his five-year plan (September 2014) which seek to ensure all schools have connectivity and technological devices for teaching and learning. According to Patel (2018) as at July 2015 ,377 township no fee schools were equipped covering 1800 classrooms of grade 12 and the following year, the project was escalated to more than 2300 classrooms of grade 11 in no fee township secondary school.

The introduction of these smart classrooms was applauded by a lot of people in the province and commended on the importance of having such technological devices in the classroom. Despite the positive effects that the introduction of technology has on education, there are some hindering factors affecting the implementation of smart classrooms. For Chukwuere and Chukwuere (2017) some parents and teachers believe that technology has negative impacts on moral values and is not beneficial for all users.

Smart classrooms were first rolled out to non-fee-paying schools in the South African townships, as well as informal settlements where most of the learners reside. Patel (2018) stressed that there was a concern regarding the safety of the devices as criminals target these schools and this disrupts the progress and implementation of the project.

The other problem that the South Africans are facing is the introduction of new technology smart classroom is lack of motivation, Bohn (2014) postulates that teachers who are intimidated by technology are resistant to the use of technology, as

they lack self -confidence and self –motivation,. “A national plan must be developed to ensure ongoing development and skills acquisition for teachers” Telkom (2015:7).

The high cost of the technological gadgets in South Africa is the other hindering factor, as some schools may not afford the costs of these tools either (Gaille, 2018). However, Bahadur and Oogarah (2013) found that, in some schools in South Africa, the teachers and learner’s motivation was increased by big multimedia interactive white boards’ screens.

2.7 SMART CLASSROOMS IN DEVELOPED COUNTRIES

2.7.1 Ireland

The introduction and integration of technology in the classroom has been part of the instruction framework in Ireland since the 1970s (The Irish National Teachers' Organisation (INTO) (2017). Throughout the years, however, genuine insufficiencies in arrangements regarding training in the use of ICT have been noted. In a 1996 report, the INTO (2017) expressed that, while the general surroundings were grappling with the fifth era of PCs, Ireland lagged behind and did not produce proficient school learners in the latest technology. Around then, the INTO had significant concerns and ascribed the shortfalls in ICT use to an absence of the government’s sense of duty regarding upskilling users and allocating sufficient finances. The INTO asserted that Irish training urgently required redirection so that learners and teachers would be empowered to adapt to fast-changing technology. Three essential standards incorporated in INTO’s strategy was that every child and instructor had to have access to educational programmes that used information technology; that all teachers in undergraduate programmes and those already employed had to be trained in the use and application of IT; and that ICT should be incorporated into the all educational programmes as a cross-curricular approach (INTO, 2017).

Other research in the 1990s upheld the INTO strategy leading to a situation where some ground-breaking schools took a proactive approach. Without a national strategy, a few schools introduced IT courses to ensure that teachers and learners would adapt to the use of IT in the classroom. Notwithstanding these early endeavours by some schools, later investigations found that there was little utilisation of ICT in teaching and learning in Irish schools (INTO, 2017). All through the 1990s, there was a progression

of projects of interest in ICT in schools on a global level and different nations were quickly overwhelming Ireland in this space.

2.7.2 Britain

Schachter (2018), postulates that in Britain, an ambitious multi-million-dollar government programme carried out in 2003 resulted in over 75% of British schools being supplied with interactive boards. The UK government provided about \$340 million to schools to develop the traditional classrooms into smart classrooms. Presently, about nearly 300 000 smart boards are being used in schools in Britain, Smart Technologies, a Canadian-based company, and Promethean, a British organisation, are the key service providers (Schachter, 2018).

British teachers are among the teachers in the world who are enjoying and experiencing the interactive feasibilities of ever-changing technology in the classroom, ensuring learners' better engagement with each other as well as educators, and receiving the best educational opportunities throughout their school careers (Schachter, 2018).

2.7.3 United States of America

In 1996, in the US, President Clinton declared an arrangement to link all US schools to the "information thruway" by 2000. Handler (2011) did research on the effectiveness of smart classrooms in the USA and concluded that smart board permitted teachers to develop more interactive and stimulating lessons for the learners. Teachers could organise their work, think more critically and be more results-orientated when using the smart board (Loschert, 2004). With technology, the work of the teacher becomes much easier to as work can be saved on the smart board and be retrieved for use in another class, which saves time, as the teacher just opens a file and presents the lesson to the next class (Handler, 2011). Learners' time is preserved, when the lesson is transferred to their own gadgets and they do not need to copy notes from the board. They thus have time to take part in the lesson presentation and discussions. Teachers have discovered that learners enjoy going to the board to participate and demonstrate something to other learners. There is better lesson participation in schools in all subjects than before, and the introduction of smart boards has resulted in teachers becoming more innovative in terms of pedagogy (Handler, 2011).

2.8 THEORETICAL FRAMEWORK

The research was pinned on TPACK as a learning theory. The theory assisted the researcher to delve into the pedagogical impact of smart classrooms on teaching and learning in secondary schools in the Tshwane South District. TPACK helped to determine the requirements to effectively integrate technology into the learning process in schools (Koehler & Mishra, 2012). George (2014) suggests that pedagogy and content must be the key component for effective technology integration. The teacher must have the necessary skills to choose the most effective method for the content to be taught. This structure consists of seven components illustrated in Figure 2.7 below.

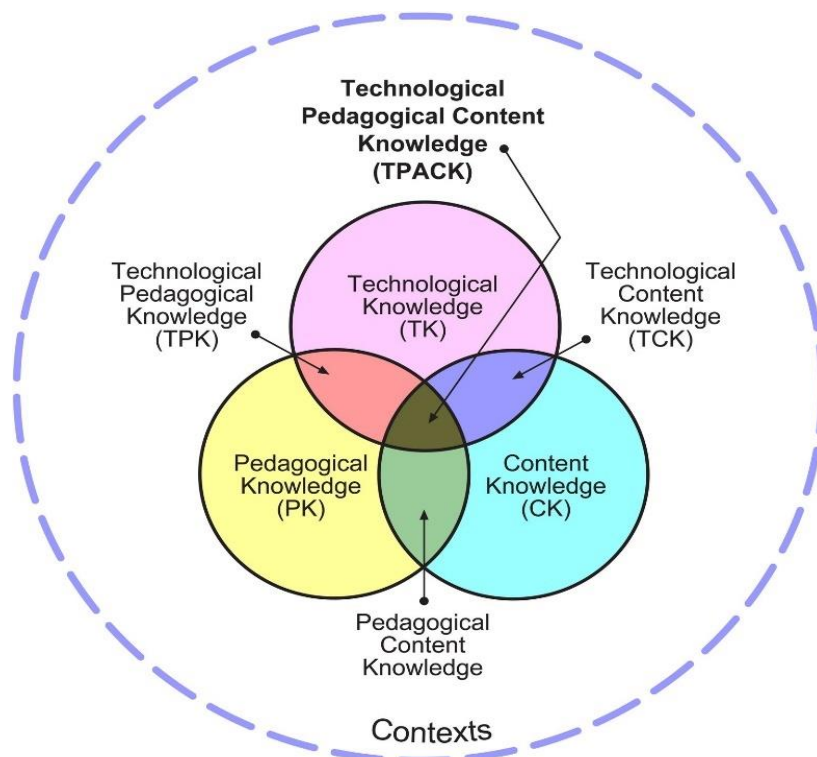


Figure 2.7: TPACK theory

Source: Koehler and Mishra (2009)

Technology integration means the addition and use of technological resources such as computers, tablets, smart boards and the internet during teaching and learning activities in the classroom (Block et al., 2015). Figure 2.1 illustrates the components of TPACK theory namely Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK) and Technological

Content Knowledge (TCK). The three components of technology meet and form TPACK. According to Koehler and Mishra (2012), this is the unique knowledge and skills that are required for effective integration of technology into teaching and learning.

In this investigation, the researcher used four mechanisms from the above theory as they suit the nature of the investigation, which are TK, PCK, TPK and TCK. Each factor is discussed below.

2.8.1 Technology Knowledge

Technology Knowledge is a comprehension of how to use computers and equipment in instructive settings. In particular, TK includes the capacity to adjust to and apply advances in technology. In this investigation, the research what to explore how teachers of grade 11 classes can apply the content acquired through training of technology application and usage in class. It is critical to note that TK exists in a condition of flux, because of the fast pace of innovations in technology (Koehler & Mishra, 2012). It includes knowing ways of running, viewing and using machines and tools to work out problems (Block et al., 2015). The teachers in this study must have knowledge and skills to use the smart classrooms. They must have had the necessary training and skills and have the knowledge of using the smart board in the classroom during the learning process.

2.8.2 Pedagogical Content Knowledge

PCK is blend of subject matter and an instructional method that is a unique combination of a teacher's expert knowledge and comprehension (Koehler & Mishra, 2012). PCK is also known as the art of knowing something (Solís, 2009). This includes incorporating skills and insight into their practice: teaching method, understanding of the learners in the classroom, the content to be taught, and the curriculum (Solís, 2009). PCK is enhanced by using various instructional methods.

PCK is explained as educators' elucidations as well as their increasing understanding of curriculum topics and how to meet the needs of a diverse range of learners (Solís, 2009). Solis (2009) added a few key components of PCK: (i) knowledge that portrays the topic content knowledge (CK); (ii) comprehension of learners' backgrounds in the learning area and projects that address a specific theme; and (iii) pedagogical facts (methodology). To sum up, knowledge has different components: (i) knowledge of

educational modules; (ii) knowledge of instructional settings; and (iii) knowledge about teaching methods (Solís, 2009). To this definition of PCK, others have added the importance of understanding the languages and social circumstances of learners in a community. PCK is not included in this study as it is not linked to the use of technology.

2.8.3 Technological Pedagogical Knowledge

TPK is having an understanding of the alteration that occurs in teaching and learning due to the incorporation of technology (Block et al., 2015). This includes the understanding of the methods and problems met during the process of teaching and learning caused by technology incorporation (Koehler & Mishra, 2012). Teachers who participated in this study must have mastered the necessary, teaching and systematic approaches to apply when teaching in a smart classroom. They must have the skills to alter the teaching methods to adapt to continuous changes during lesson delivery. TPACK is the main and underlying framework for competent and useful integration of technology in the classroom (Koehler & Mishra, 2012).

2.8.4 Technological Content Knowledge

TCK means understanding how technology and subject content influence each other (Block et al., 2015). Educators need to know more than just the subject they teach. Educators must have a deep comprehension of the strategies of how the subject can be presented using smart classrooms in the teaching process. They must be able to choose which method best fits the particular content to teach.

2.9 CONCLUSION

This chapter presented a critical analysis of the smart classroom and its implications for teaching and learning. The related literature on the pedagogical impact of smart classrooms in teaching and learning was discussed. The benefits and challenges faced by teachers when using smart classroom were highlighted. The introduction and impact of smart classrooms in other countries where smart technology was commissioned before being introduced in South Africa was also examined. TPACK, the theoretical framework on which the study was based was explored.

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

Chapter 1 addressed and explored the phenomenon of this investigation, and Chapter 2 gave a review of related literature and theoretical framework of this study. Chapter 3 presents the methodology used when conducting this study. The chapter provides the paradigmatic perspective and research design for the investigation and justifies the sampling techniques followed. The techniques and procedures used to collect and scrutinise the data for this study are discussed in this chapter. Lastly, measures to ensure trustworthiness and ethical considerations to be cohered during the study are examined.

3.2 PARADIGMATIC PERSPECTIVE

A research paradigm is the frame of reference for conducting the study (Babbie & Mouton, 2013). It is based on what the researcher believed will lead to the answers to the research question (Denzin & Lincoln, 2005). An interpretivist paradigm was used, where researcher seek to investigate human experiences (Hlagala, 2015). In this study, the researcher investigated teachers' actions and opinions on using smart classrooms in their teaching and learning. Creswell (2013) states that people interpret the world through engagement and interaction with given situations. Interpretive research holds that interpretations by individuals are seldom the same as they tend to be affected by those who create them; in other words, they are subjective (McMillan & Schumacher, 2014).

This approach portrays that facts, information and skills are endlessly created and recreated by a person or a group of individuals or a community (Donald, Lazarus & Moolla, 2015). Interpretive techniques for research begin from the position that our insight into reality is individualistic and cannot be proven in a scientific way. Accordingly, there are no results which can be proven by scientists and repeated by others, which is different from the approach of positivist researchers (Guest, Namey & Mitchell, 2013). Interpretivism is based on the on the assumptions that there are many realities and as a researcher, the researcher carried out my investigation in natural settings to achieve the best possible understanding and acknowledge that there is some degree of subjectivity in the interpretation of the results.

3.3 RESEARCH METHOD AND DESIGN

Figure 3.1 below is an illustration of the research method and design.

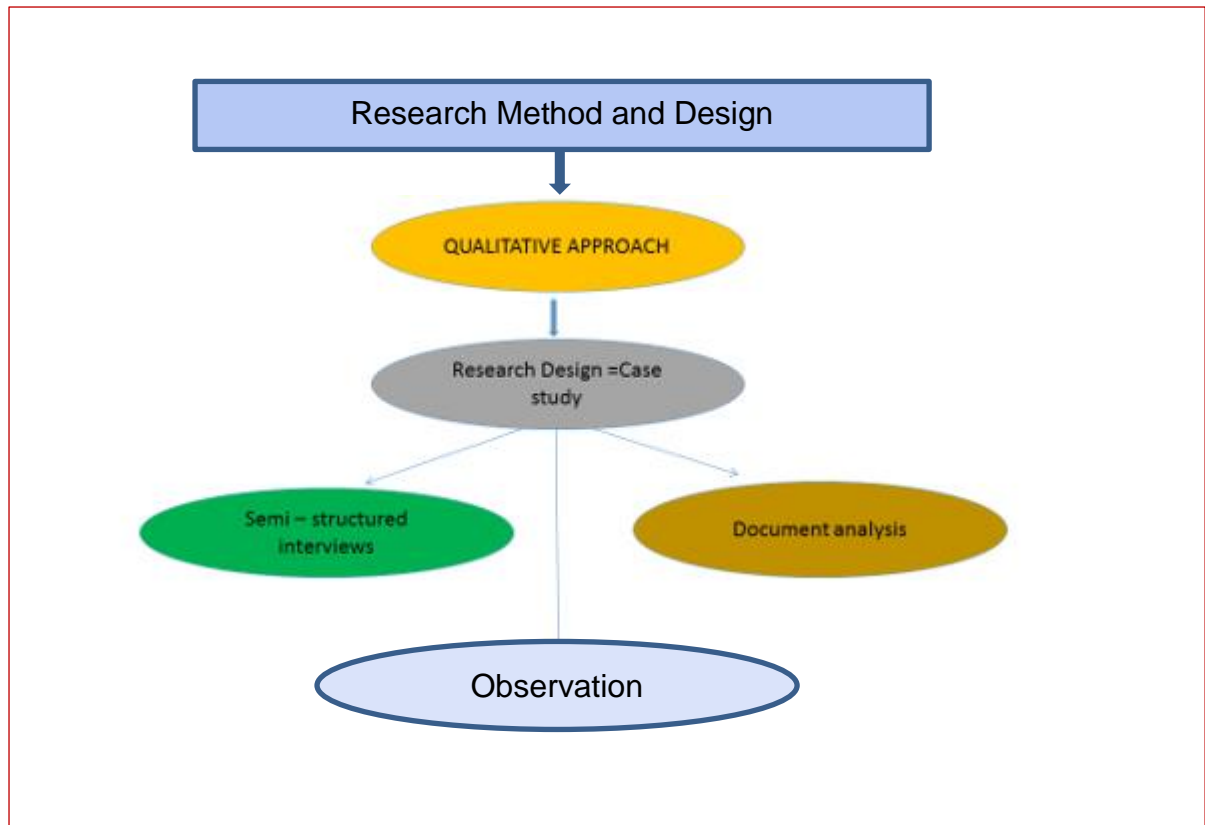


Figure 3.1: Research method and design

Figure 3.1 provides a diagrammatic overview of the choice of the qualitative research approach using multiple case studies and the choice of data collection strategies namely semi-structured interviews, document analysis and non-participant observation. These are discussed below.

3.3.1 Research Method

This study used a qualitative approach. A qualitative research approach consists of different realities and that the world is not a target thing yet an undertaking of individual understanding rather than facts and beliefs as a result of visual things (Creswell, 2014). In this study, the researcher will use facts and ideas from the participants not numbers. For Jacobsz (2015), in a qualitative study, data are collected in a natural setting. The approach was preferred for this study because of its suitability to explore the experiences of the participants in their environments (Glosne, 2011). The five

selected secondary schools were used as natural settings and were suitable for this study due to the availability of smart classrooms. The researcher employed this approach in this investigation to collect facts and come up with a detailed understanding of the pedagogical impact of smart classrooms in teaching and learning currently used in selected secondary schools Tshwane South District.

Maree (2013) suggests that the greatest advantage of qualitative research is the depth and richness of the results obtained. It is for this reason that the subjective methodology was regarded as suitable for this investigation as it enabled the researcher to comprehend the encounters and perceptions of teachers currently using smart classrooms when imparting knowledge to Grade 11 learners in selected secondary schools.

3.3.2 Research Design

A research design is the researcher's arrangements for the study and to provide an audit trail that readers of the research can follow (Creswell, 2012). These are the procedures the researcher had to follow when carrying out the investigation. In addition, Terre Blanche and Durrheim (2002) explain that a research design is a methodological structure which links research questions with the way the study is executed. It is a way that guides the research when conducting a study. Similarly, Yin (2011) emphasises that the research design is an intelligent well -structured procedure to be followed when conducting a research so as to address the underlying questions. Ngulube (2013) and Ravitch and Carl (2016) also asserted that research designs include the methods for finding exhaustive, precise and trustworthy information. Moreover, McMillan and Schumacher (2014) point out that research design includes determining who the participants will be; i.e. from whom and under which circumstances the data will be collected and how the findings will be analysed.

It is in the above authors' perspectives about research design show how essential the design is when undertaking an investigation. Therefore, in this study the researcher employed a multiple case study research design for this study. A case study is the study of phenomena, using one or more cases in a bounded system, with the aim of understanding each case in the study (Zimmerman, 2016). It is a qualitative technique where the researcher uses numerous forms of information collection modes such as interviews, observations, documents and reports to explore a phenomenon or

problems over period of time (Creswell, 2014). The strength of a case study, according to Phakiti and Paltridge (2015), is that it is a suitable method to use when the researcher wants to gain a deeper understanding of a phenomenon and it gives the researcher a holistic approach to study a matter of interest in its natural setting. In this study, the researcher investigated teachers' daily practices and experiences in the use of smart classrooms for teaching and learning. In this study, the pedagogical impact of smart classrooms on teaching and learning in Grade 11 classes in the Tshwane South District was the problem under investigation. The multiple case studies were the five selected secondary schools in the Tshwane South District.

3.3.3 Population and Sampling

McMillan and Schumacher (2014) define a population as the whole group from which a sample is selected. The sample is a group of individuals from whom data is retrieved. Sampling is a decision that the researcher makes in relation to from where and from whom the data are gathered (McMillan & Schumacher, 2014).

According to Creswell (2014), the most reasonable qualitative sampling technique is purposive sampling in which the researcher actually selects people or locales to learn or comprehend the focal marvel. For Given (2012), purposive sampling is when the researcher selects the individuals to be part of a sample based on the fact that they would have experience of the problem investigated. Purposeful sampling is a procedure of handpicking data-rich respondents who would have vital information or issues that are fundamental to the motivation behind enquiry (Cohen, Manion & Morrison, 2007). Forrester (2010) states that purposive sampling allows for gathering data until no new data arise out of the questions. This method gave the researcher the opportunity to choose participants who could provide the necessary data. The teachers' expertise and experiences in the use smart classrooms were vital to this study.

For this study, the researcher requested 10 teachers, two from each of the five selected secondary schools in the Tshwane South District to participate in the study as they use smart classrooms for teaching and learning.

3.3.3.1 Selection of the participants

The participants used in this study were 10 Grade 11 secondary school teachers who use smart classrooms daily in teaching. The researcher personally went to the five schools and asked for permission to meet Grade 11 teachers from each school who use smart classes. The researcher explained the purpose of the study to Grade 11 teachers at these selected schools. At two schools, two teachers volunteered to participate in the study. At the other three schools, more than two volunteered, therefore, the researcher wrote the names of those interested teachers and put the names in a box and the first two picked took part in the study.

3.3.4 Data Collection Methods

To collect qualitative data, semi-structured interviews, document analysis and non-participant observations were used. Maree (2013) articulates that the qualitative data-collection methods commonly used include field notes on observations of smart lessons, individual semi-structured interviews with teachers who have experience with the phenomenon being investigated.

Figure 3.2: below illustrates and summarises data collection strategies

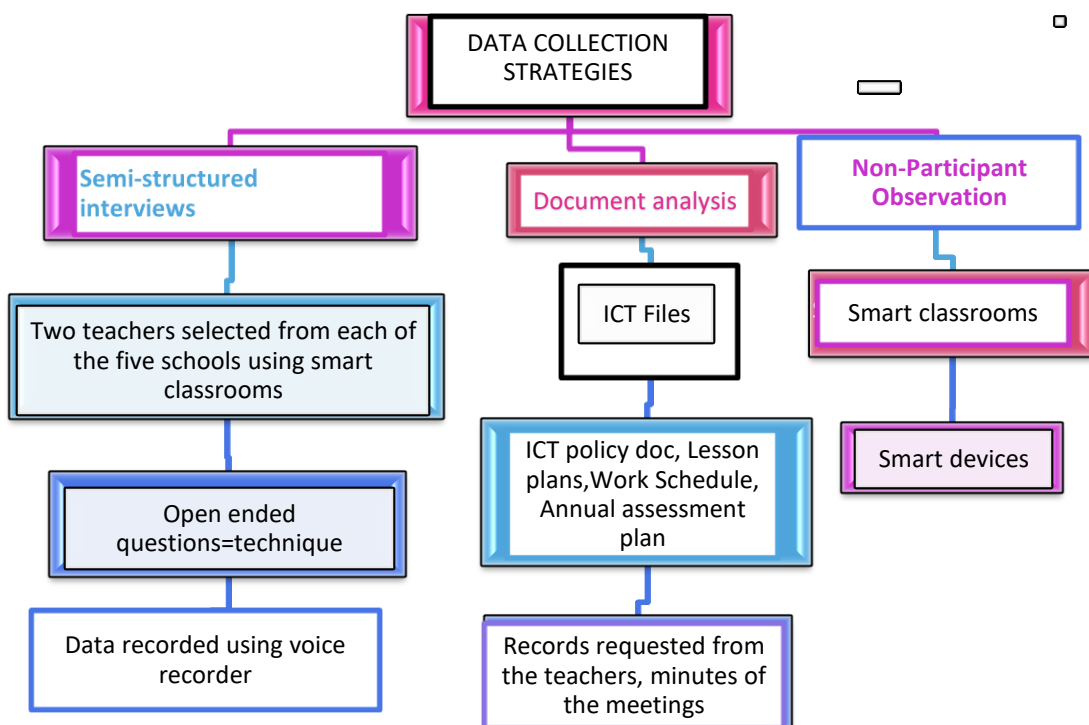


Figure 3.2: Data collection strategies used in this study

Figure 3.2 illustrates the data collection strategies which include semi-structured interviews, non-participant observation and document analysis.

3.3.4.1 Individual semi-structured interview

Phakiti and Paltridge (2015), and Maree (2013) explain an interview as a data collection technique which uses a two-way discussion where the interviewer asks participants questions about their experiences. Essentially an interview is a meeting between a researcher (one who wishes collect data of interest on a particular matter) and a participant (one who probably has rich information about the matter) (McMillan & Schumacher, 2014). Maree (2013) further notes that interviews may be open-ended, semi-structured and structured interviews. In the context of this study, the researcher used semi-structured interviews with open-ended questions because they provided the researcher with more control over the topics discussed in the interviews. The questions were compiled into an interview guide and were based on the problem being investigated (Appendix A).

Muyambi(2016) states that semi-structured interviews allow the researcher to deal with the procedures and the subject to be scrutinised, while the participants are free to express themselves as they wish. They empower researchers to get data they cannot obtain by perception alone. During the procedure, researchers should be aware of their own feelings and prejudices and take notice of participants' non-verbal cues to determine whether there might be some "hidden data" to look for (Berger, 2016).

The researcher interviewed two teachers at each of the five selected secondary schools for the study. The duration of each interview was about 20 to 30 minutes and one lesson observation per teacher. The duration of the lesson varied from 35 to 45 minutes depending on the school's timetable. These participants were teachers teaching Grade 11 using smart classrooms. The researcher first made appointments with each of the teachers who volunteered, and these interviews were conducted at a convenient time for the participants. The semi-structured interviews were held at the participants' schools in a place where they were comfortable.

The answers given by the participants permitted the researcher to ask follow-up questions. This empowered the researcher to gather rich data. Prior to starting the

discussion, the researcher requested the participants' agreement to record the interview using a voice recorder to catch each word of the participants' perspectives and thoughts. Notes were also taken. This resulted in effective data collection.

3.3.4.2 Document analysis

Document analysis is a research procedure used to get information with little communication between the researcher and the participant. It is non-intuitive and requires analysis to find pertinent information (Jacobsz, 2015). According to Maree (2013) and Willis (2008), data gathering techniques focus on the kinds of documents that give the researcher more information on the phenomenon being discussed. and In this study, the researcher used the ICT files to gather more data.

The researcher examined the ICT policy files at each school to check if they addressed the implementation and usage of smart classrooms as well as the Annual Teaching Plan, work schedules and lesson plans in the files, as these documents are used in everyday teaching and learning exercises. At the schools, ICT coordinators and teachers are supposed to keep files with policy documents, minutes of meetings and other relevant sources of information that may be useful to this research. The researcher asked for the ICT file from the ICT coordinator at the schools and checked if the schools had an ICT policy document. The researcher used Appendix B as a document checklist.

3.3.4.3 Non-participant observation

An external person who is not part of system does observations (Maree, 2013). Observations are carried out to provide a better understanding of a phenomenon, since they supply data under characteristic and normal conditions (Kalanda, 2012). McMillan and Schumacher (2014) assert that observation is another form of data gathering information where the researcher personally observes a phenomenon in its natural environment without influencing what is happening at the time. The purpose of non-participant observation is not only to see what is going on but also to feel what it is like to be part of the group. Field notes are a critical part of observation because they aid the researcher in collecting and remembering information from observation sessions. During the non-participant observation, the observer (researcher) wrote notes. One needs to include information such as who was present, what the learners

were doing, what materials were used, how long each activity lasted and whether there were interruptions (Martella, Nelson, Morgan & Marchand-Martella, 2013).

During the non-participant observation sessions, the researcher observed Grade 11 lessons of each of the ten participants, writing notes on how they taught using the smart classroom. A checklist (Appendix C) was employed as a tool for data gathering.

3.5 DATA ANALYSIS

Data analysis includes examining the information gathered and putting it into categories that will help to answer the research questions (Creswell, 2014). Using a qualitative or subjective design, the primary stage involves sorting out the information, transcribing interview recordings and composing field notes, and deciding whether to analyse the information manually or by using software (Creswell, 2012).

The researcher employed thematic analysis approach in this study. Thematic analysis approach is one of the most widely recognised types of analysis in subjective research (Creswell, 2014). Creswell further states that the thematic analysis process is done in six phases to determine meaningful trends. The phases include acquainting oneself with data, creating initial codes, deriving themes from codes, probing themes, naming and redefining themes and creating the actual report (Creswell, 2014). The themes are designs or patterns arising from the data collected that are vital to the description of a phenomenon. The themes become the classes of analysis. The researcher went through the information gathered, coded it and grouped it into different categories to determine the themes. More analysis was then done to refine the data for the final report. Chapter 4 covers this process in detail.

3.6 MEASURES TO ENSURE TRUSTWORTHINESS

Bless and Higson-Smith (2013) assert that trustworthiness in qualitative research is done in terms of how much trust or faith people have in your research process and the findings. Some of the identified measures to ensure trustworthiness and high quality are credibility, dependability, transferability and conformability (Bless & Higson-Smith, 2013). The researcher strived to ensure and achieve high trustworthiness through the following two pillars of Babbie and Mouton's (2013) elements of trustworthiness, namely, credibility and transferability.

3.6.1 Credibility

Credibility is the extent to which the information gathered is correct and reflects the truth of what was investigated, Babbie & Mouton, (2013). It seeks to determine if one can believe the research findings and conclude that the results are true and real. Bless and Higson-Smith (2013) maintain that credibility means that the outcomes are a true reflection of the real world and are logical. To ensure credibility the researcher used triangulation, consistent observation, member checking and peer debriefing.

3.6.2 Triangulation

Triangulation means using more than one technique to collect data. It is a way of checking the extent to which the information gathered from at least two sources is consistent (Honorene, 2017). Nevertheless, the motivation behind this technique is not really to validate information but to discover distinctive elements of the same phenomenon.

In qualitative research, researchers normally use triangulation to ensure that the report is comprehensive (Merriam and Tisdell, 2015). Triangulation is used because a solitary technique can never sufficiently clarify a phenomenon. Using different techniques can encourage a deeper comprehension. Denzin (1989) contends that triangulation in qualitative research means that if at least two sources of information produce results that coincide, the research can be classified as dependable.

For Honorene (2017), triangulation includes using different information sources in an investigation to create a better understanding of a particular phenomenon under investigation, to ensure that the research results are objective and unbiased. In this study, the researcher used multiple participants as sources of information to investigate the pedagogical impact of smart classrooms in teaching and learning of Grade 11 learners. The researcher used more than one data collection tool to collect data, namely, semi- structured interviews, non-participant observation and document analysis so as to widen the chances of obtaining reliable and adequate information.

3.6.3 Consistent Observation

According to Lincoln and Guba (1985), “the reason for prolonged engagement or commitment is for the researcher to be exposed to different impacts, the shared

shapers and logical variables that encroach upon the phenomenon being investigated". Consistent observation is done to identify those attributes and components in the circumstance that are most applicable to the issue or issue being sought after and concentrating on them in detail. This was achieved by the researcher through observing participants in this study and using a checklist to record the observations.

3.6.4 Member Checking

Member checking is a subjective method used to confirm the credibility of the results (Lincoln & Guba, 1985). They further say that this should be possible both formally and casually as part checks may be done during a discussion; for example, the researcher may ask a participant to clarify an answer. Lincoln and Guba (1985) state that member checking is a method for ensuring thoroughness in qualitative research, recommending that validity is innate in the exact descriptions of phenomena. For Figg, Wenrick, Youker, Heilman and Schneider (2010), member checking, otherwise called member or respondent approval or validation, is a system for investigating the believability of the results. Transcripts or results are returned to respondents to check that they correspond with what they said during the interviews.

According to Merriam and Tisdell (2015), participants may be asked to review transcripts from the interviews in which they have participated. Here the emphasis ought to be on whether the interviewees agree that the researcher has correctly captured what they really planned or intended to say. Generally, member checking involves either sharing a short discussion of the findings or revealing all the findings to the research participants. In this study, the researcher went back to the participants after transcribing the interviews and asking them to review the transcripts of their interview. This was to ensure that members had a chance to review what they had stated, include more data in the event that they needed to, and to alter or correct what they said. It was also done for accuracy of the findings of this study.

3.6.5 Peer Debriefing

Lincoln and Guba (1985) define peer debriefing as a procedure of presenting oneself to an unengaged companion to explore parts of the research that may reveal researcher bias. The purpose of questioning is intensive logical testing; a debriefer

can reveal those inclinations which are frequently underestimated, points of view and presumptions on the researcher's part are additionally subject to challenge in companion questioning. This procedure causes the researcher to be mindful of the need for complete objectivity in presenting the information and analysis. Peer debriefing guarantees the dependability of a subjective study. Through questioning, the debriefer investigates the research plan, the information gathering procedure, and information analysis, with the aim of encouraging the researcher to look at the investigation from numerous viewpoints (Figg et al., 2010).

In this study, the researcher was guided by his supervisor who checked his analysis and findings to ascertain if it had been done properly and which areas needed to be corrected.

3.6.6 Transferability

Transferability as postulated by Bless and Higson-Smith (2013) is the degree to which investigation discoveries can be connected to comparative settings. In this investigation, the data about the setting of the study was given. To ensure transferability, the researcher described the phenomenon in detail so that other researchers could potentially use the same processes in different settings and circumstances and with other individuals (Babbie & Mouton, 2013) and arrive at similar conclusions. Merriam and Tisdell (2015) adds that qualitative inquiries are frequently explicit, and the discoveries are appropriate for a specific domain or a small group of people, so that it is very hard to prove that the discoveries and conclusions would be relevant in different circumstances using different samples. Bless and Higson-Smith (2013) suggest that it is an obligation of the researcher to ensure that sufficient relevant data on the fieldwork are provided to allow for the transferability of the research. However, since this study is qualitative, the results cannot be generalised.

3.7 ETHICAL CONSIDERATIONS

According to Given (2014), the researcher should minimise or avoid disruptions of the environment and the life of the participants and gain informed consent wherever possible. In this study, this was done through explaining the purposes of the study and reading through the request to participate as well as signing consent forms (Appendix H and I). The letter of request explains all terms and conditions of the research and

consent forms should be used to formally request the participants to give permission to include them in the project (Creswell, 2014).

The ethical requirements of UNISA, intended to direct the exploration of an investigation of this sort, were carefully followed. The researcher applied for ethics clearance from UNISA College of Education REC. Data were not collected before the committee issued the clearance certificate. It was also essential that the researcher receive the appropriate formal research ethics clearance before conducting fieldwork. The researcher completed and submitted the necessary forms required by the Department of Education for ethical clearance. The researcher wrote letters to the principals of the five selected secondary schools to be used in this study.

The researcher observed the principles of anonymity, voluntary participation, confidentiality and completion of consent forms that ensured respect for the rights all participants. Participants were informed of anticipated effects, including risks, potential harm or benefits. The researcher stressed that taking part in the entire study was purely voluntarily and was not linked to any rewards, material gains or services. Participants had the right to withdraw whenever they felt the need to do so and were nor required to give any explanations.

Letters of the alphabet were used as none of the participants' names or identities were included in the study. To maintain anonymity and confidentiality in this study, participants were coded as A1, A2, B1, B2, C1, C2, D1, D2, E1 and E2.

3.8 CONCLUSION

The purpose of this chapter was to show the research plan and the methods used when gathering information from the participants. The research design was illustrated and explained. The strategies used for information accumulation and analysis were described. The chapter closed with a discussion of the methods used to ensure the credibility and reliability of the findings. The moral or ethical rules followed in the procedure of data gathering were likewise explained.

CHAPTER 4: PRESENTATION AND DISCUSSION OF FINDINGS

4.1 INTRODUCTION

Chapter 1 identified the phenomenon that this study sought to address and explore, while Chapter 2 provided a review of related literature for the study and a detailed description of the phenomenon under investigation. The chapter also covered a discussion on the use of the smart classroom in developing and developed countries. The theoretical framework TPACK, on which the study is pinned on, was also discussed. The benefits of the smart classroom were summarised in Chapter 2. Chapter 3 presented the research methodology and tools that were used in conducting this study.

This chapter provides a description of the research sites and participants. It includes an explanation of how the data analysis was done by means of thematic analysis. The purpose of the investigation was to explore the pedagogical impact of the use of smart classrooms by Grade 11 teachers to facilitate the teaching and learning in the Tshwane South District.

4.2 RESEARCH SITES

4.2.1 Site Selection

The study was conducted in five English Medium schools in the Tshwane South District. For this study, the participating schools are referred to as School A, B, C, D and E. School A was the first and School E was the last school to be interviewed. All five schools were public secondary schools and were using smart classrooms for teaching and learning. A smart classroom is a modern classroom in which technology is used for teaching and learning processes. In a smart classroom, the teacher uses a smart board in place of the traditional chalk board.

School A had nine smart classrooms installed by the GDE. The school was a fee-paying school and located in the low-density suburbs with the majority of of the community being Indians. According to the ICT coordinator, the School Governing Board (SGB) was planning to construct more smart classrooms using their own budget. The school had an enrolment of about 1 100 learners, one principal and two deputy principals. There were 49 teachers at this school and six of these teachers

were heads of department (HoDs). There was one intern at the school. Interns are deployed to schools with smart classes and are supposed to offer technical support to the teachers regarding the use of smart classrooms.

School B had 10 smart classrooms that were built by the GDE. The school was a non-fee-paying school and was located in a high-density suburb. The school was constructed, maintained and funded by the GDE. It had an enrolment of 960 learners. The school had one principal, a deputy principal, 29 teachers and five HoDs. This school had one intern.

School C also had 10 smart classrooms installed. It was situated in a high-density suburb of Tshwane with an enrolment of just over 1 000 learners. It was a non-fee-paying school. This school was constructed, maintained and funded by the GDE. The school had one principal, two deputy principals and 35 teachers with five HoDs with one intern, who rendered technical help to teachers who used the smart classrooms.

School D was a fully resourced ICT school compared to the above-mentioned schools. This means that all classrooms were smart classrooms and there was a smart board installed in all classroom. Unlike other schools where only Grade 10 to 12 classes had smart boards, at this school all rooms and grades had and used the same technological devices. It was a non-fee-paying school. This was constructed, maintained and funded by the GDE. The school had an enrolment of about 1 250 learners and was also located in a high-density suburb of Tshwane. The school had one principal and two deputy principals. There were 46 teachers and six HoDs as well as four ICT interns.

School E had six smart classrooms installed. The school is a non-fee-paying school and the school was situated in a high-density suburb of Tshwane, with an enrolment of about 850 learners. The school had one principal and one deputy principal. It has five HoDs. It had 27 teachers, all on the GDE payroll. At this school, there were no interns, but the ICT coordinator was expecting one to be appointed at the school

4.2.2 Participants

Table 4.1 below shows five schools from where the participants were selected, the number of participants per school and the type of data collected. The 10 participants who were selected on basis that they taught Grade 11 classes using smart classrooms

on a daily basis. Six of the participants were allocated Grade 10 to 12 classes on their timetables while four participants had Grade 11 and 12.

Table 4.1: Participants' profiles

	School A		School B		School C		School D		School E	
Participant No.	A1	A2	B1	B2	C1	C2	D1	D2	E1	E2
Type of School	Secondary		Secondary		Secondary		Secondary		Secondary	
No. of participants interviewed	Two		Two		Two		Two		Two	
Gender	Female	Male	Female	Female	Male	Female	Male	Male	Female	Female
Ages	34	43	32	46	42	52	58	49	59	43
Subjects Taught	Life Science	English	Tourism	Life sciences	Geography	Mathematics	Business Study	Life Orientation	History	Physical Science
Years of experience	5	17	18	25	13	24	30	19	33	14

The above table illustrates that five schools that were selected and they were named A, B, C, D and E for anonymity and confidentiality reasons. All the schools are secondary schools from which two teachers were selected. The participants were six women and four men whose age groups ranged from 30 to 64 years. The participants had been teaching for between five and 33 years. Thus, these teachers were suitable for this study due to their interaction and daily experiences with learners in smart classrooms.

For the purpose of anonymity and confidentiality of the participants, the following codes were allocated: A1, A2, B1, B2, C1, C2, D1, D2, E1 and E2. The letters A to E represent the schools according to the order of visits and interviews. The numbers 1 or 2 represent the teachers according to the order of visits and interviews.

Each participant was interviewed using a semi-structured interview guide with open-ended questions and non-participant observation was done with each of the participant as well as document analysis. In this case the ICT file was analysed looking at ICT policy documents, work schedules, lesson plans and annual assessment plans.

4.3 THEMES FROM DATA ANALYSIS AND SEMI-STRUCTURED INTERVIEWS

From the analysis of the data gathered from the semi-structured interviews (Appendix D), six themes emerged and are discussed below,

4.3.1 Environment

When responding to the question “How often do you use the smart classroom?”, the findings revealed that eight participants are using smart boards in almost all their lessons. Two were still trying to figure out how to use technology in their classes. It was Participant E2, who expressed that:

“Smart classrooms have created an environment that is conducive to learning and it caters for all learners’ learning needs and difficulties.”

Participant B1 echoed similar sentiments when she said:

“I use smart classrooms most of my time, it has changed my teaching way as aim living in a new world full of technological gadgets and now enjoy my teaching.”

The integration of smart technology in education has created an environment which can make learners keener or interested to learn. This is supported by the statements made by Pourciau (2014), namely, that technology is a part of the everyday world; educational leaders need to change the classroom as well as assume the roles in education; and a paradigm shift is necessary for teachers to accept technology as an assistive tool. In schools where smart classrooms were installed, indeed, there is now a new look and setup where whoever goes into such a classroom would be keen to know more about what they see. A smart classroom is a combination of technological electronic tools used in learning activities and promotes a conducive technological environment applicable to education (Block et al., 2015).

4.3.2 Training

Responding to the question “Did you receive training on the use of smart classrooms?”, five participants agreed that they received training on the use of technology in classrooms.

Participant B2 said:

“Yes, we received training.”

This was supported by Participant E2 when he said:

“Yes, our facilitators trained us.”

Two said they were trained but the training was not enough. They are not well equipped with skills to operate the new system. Participant C1 stressed that:

“No well-structured training was done with the teachers.”

The other three participants were not trained, and they lack the skills and proper knowledge of how to deliver their lessons using technology. According to Nagel (2014), this leads to underutilisation of the programme or the technology being abandoned without anyone to take care of it. Mishra and Koehler (2006) suggest that in the TPACK framework that three components are key to effective integration of technology in the classroom: what to teach, how to teach and the knowledge and skill of teachers to use the available technology appropriately.

Technology Content Knowledge means having an understanding of how technology and substance influence each other (Block et al., 2015). Teachers need to master more than the subject matter they teach. Teachers must have a clear understanding of the technology in which the content can be adapted using smart classrooms in their teaching (Koehler & Mishra, 2012). They must be able to choose which technology best fits the particular content to teach. Participant B1 emphasised that:

“The key to effective utilisation and proper implementation of these smart classrooms is pinned on what type of training is there for teachers.”

The teacher went on to say:

“We did not receive proper training but workshops which I think even the trainer was not equipped with the skills.”

Nagel (2014) states that key among all difficulties is the absence of sufficient, continuous professional development for teachers who are required to incorporate new advances into their classrooms, yet they are ill-equipped or unfit to do this. Most of the teachers lack the technical knowhow to operate this new technology. No proper

training is done for the implementers of the programme. Teachers lack the skills and knowledge to use specific applications when using technology.

4.3.3 Improvements in Teaching and Learning

Responding to the question on the experiences of the participants in using smart classrooms, the findings from the 10 participants showed that indeed there is a noticeable improvement in teaching and learning in classes. The participants gave different perspectives. Participant A1 advocated that smart classrooms had made her life and teaching easy as the system is conducive to a variety of teaching methods. She went on to say:

“When teaching Life Sciences, there is a wide range of media on internet and these smart classrooms have brought the reality element to class when connected to internet.”

Smart boards are wide enough for all learners to see regardless of their sitting positions in the class. Participant B1 said:

“The teacher can enlarge texts as well as images so that everyone can easily see clearly.”

Participant 2 also said:

“There are a lot of recorded videos that teacher can choose from to suit their content and subject.” ... “Today’s learners are more technologically inclined as they enjoy to explore more using these gadgets.”

Donald et al. (2015) postulated that teaching and learning must be active full of exploration and experiments to discover things. According to Participant E1:

“Some of our learners can go home and download videos to support and help them during classes and this has made teaching enjoyable and easier than before.”

Participant A2 expressed the following:

“Smart technology saves time in teaching. All the lesson plans are loaded on the net. E-Textbooks and resources are loaded on the smart board which makes the work easy as there is less time in planning the lessons.”

With smart software, learners can be tested using clickers that mark the tests for learners and get answers instantly. Participant A2 also stated that:

“The other way in which time is saved is through the use of presentations.”

Indeed, one presentation can be watched by the whole class in a period than be used in the next period, rather than writing on the chalkboard, from one period to the other, and it is tiresome. According to Participant B1:

“Smart boards help learners to improve their psycho-motor skills when they use their fingers to move objects and write on the touch screen.”

These boards integrate diverse technology such as microscopes, mobile phones and calculators; thus, they are interactive and provoke active learner participation. Participant B1 further explained that:

“Some of the learners have found joy in the touch screen and it makes them become more interested in learning.”

These smart classrooms are environmentally and user-friendly, as well as it is paperless. Most of these classes are smart and neat. This was supported by Participant C2's sentiments when she said that:

“There is no more litter on the floor in my class due to the reduction in the use of worksheets and papers in our schools.”

This is supported by Matwadia (2018:2) who states that “In today's digital age, these educators believe that a paperless classroom promotes a more efficient and organised classroom while preparing learners for the practical world outside classroom walls”. Participant B2 said:

“When teaching Life Sciences, there is a wide range of media on internet and these smart classrooms has brought the reality element to class when

connected to internet. The three-dimensional media will bring life to class. For example, a heart can be viewed in 3D pumping blood into the vessels, in its original colour.” ... “This will make the learner fascinated and increase their desire to learn more. Thus, the use of smart classrooms with internet connectivity is another added advantage of these smart classroom.”

Nel, Nel and Hugo (2013) advocate that learners’ visual perception is developed by being exposed to a variety of pictures where spotting the differences and similarities, analysis and synthesis as well as visual-motor integration foster further understanding. Thus, the use of visual aids is key to learning. Participant C1 also said that:

“Learners are enjoying the use of social media to learn. I can post a video on WhatsApp group even when I am absent, learners go through it and then answer questions sometimes I use BYOD meaning Bring Your Own Device, where learners bring their own smart phones and use them throughout the whole lesson for internet and class activities.”

Most of the learners are comfortable using their own devices and this was working in the classes, the researcher observed. The majority of the learners in these classes were below 25 years old, which means they were born and grew up after the adoption and utilisation of digital technology. Prensky (2001) named this age group ‘digital natives’ and described this age group as those born and raised in the digital age who regard technology as a key component of their lives. However, the majority of the participants were between the ages from 35 to 65 which means they were born and grew up before the adoption and utilisation of digital technology. Participant D1 stated that:

“Smart classroom has helped me in realising how wonderful teaching is. When I heard about the introduction of the smart classrooms. I was not happy because I was very comfortable with the traditional chalkboard and as I was born before Technology (BBT), thought my teaching will be miserable. I have since realised that technology has made people’s life easy. I can record my lessons in audio and visual so that I do not repeat teaching the same things to the next class but play for them. I also share the videos with my colleagues from other schools.”

Smart boards have the facility to record lessons that can be played at any time. The lessons can be saved on the smart board or an external device. Participant E1 has also discovered the importance of these smart classroom in her teacher career. She said:

“It has made me to be more innovative in the way I do my teaching. I can now vary my teaching methods everyday as there sufficient and abundant resources on loaded on the smart boards and internet.” ... “Lesson participation and learners’ involvement has drastically improved as learners are now actively involved in learning as everyone want to come and demonstrate something on the smart board, thus, improving their understanding of the content being taught. Those who fully understand and are able to manipulate the tools on the smart board would want to show off to fellow learners.”

Some of the learners are also helping teachers in schools to discover how some of the tools on the board work. Some learners discover things faster than other and are keen to explore more. Participant E1 concluded by saying:

“I am now addicted to the digital tools and cannot imagine how I will teach using a chalkboard.”

Participant E2 mentioned that:

“The use of smart classroom has resulted in improved teacher-learner interaction in class. Learners are more active in the modern classroom as they are surrounded by technology everywhere and every day.”

These learners have mastered smart phones that operate just like the smart board. Participant E2 went on to say:

“Learners are learning or can study through the use a variety forms media such as photos, graphs, maps, posters and animated videos. They can easily grasp information as they see the images. Smart technology provokes the thinking capacity of learners as they learn by themselves.”

Thus, this technology has promoted or resulted in learners’ freedom of expression, thereby expanding their thoughts and develop new 21st century skills and ideas. According to Gunter and Gunter (2012), 21st century skills are skills that prepare

learners to be effective workers, leaders and citizens in the new digital global world. These skills include creativity and innovation, communication and collaboration, as well as critical thinking and problem-solving.

4.3.4 Technical Faults

When responding to a question about challenges they had when using the smart classrooms, the findings revealed that six participants indicated malfunctioning of smart boards. They stressed that sometimes the devices malfunctioned. The other four said there was a lack of technical and maintenance support. Participant C2 said:

“The major hurdle we are facing in schools is the technical support to the smart boards. In schools, teachers spent almost a month or more waiting for a technician from to department to come and fix the problem. The interns based at some of our schools are offering little or no support as they lack this technical knowhow.”

Foradian (2013) supports this by saying that one of the most problematic aspects of smart boards is that they are electronic gadgets and are prone to technical faults. This can happen in the middle of a lesson delivery and this may impact on the enthusiasm of learners to learn. Teacher would then have to abandon the lesson to look for a technician if there is one in the school. If no help is obtained, then that lesson will be a failure. Participant A2 said:

“At my school, sometimes the boards do not work due to technical problems and proper training. This can happen any time,”

while participant D1 expressed that:

“Some boards are not working most of the time due to dust or what they call orientation.”

This in turn can cause loss of focus and concentration among learners as they tend to access suspect websites while the teachers are trying to fix or are concerned with the malfunction of devices. For Foradian (2013), technical faults that may occur in the middle of a lesson delivery have an impact on the enthusiasm of learners to learn. These malfunctions can also lead to loss of teaching time as teachers will be looking for or waiting for technicians.

4.3.5 Timesaving

This theme emerged when the participants were responding to the question “What are the positive outcomes of integrating smart classrooms in your school?” Most of the participants stressed that the introduction of smart classrooms was vital in their teaching as it helped to save time. Participant A1 said:

“Smart classrooms have made my life and teaching easy as I spend less time teaching and planning my lessons now.”

Participant E2 said:

“I can cover more content in a short time and reach out to my learners anytime if they are online.”

Handler (2011) attests to the fact that with technology the work of the teacher becomes much easier to as work can be saved on the smart board and be retrieved for use in another class, and this saves time as the teacher just opens a file, and presents the lesson to the next class. Teachers can use the internet to find materials they may require for their lessons, and then do their lesson plans and preparation at home. They can then transfer the work on to the smart boards for use during the lesson presentation. The teacher can make and record a lesson presentation using power point and present this to more than one class, thus saving precious time for the teacher. Learners’ time is saved, when work is transferred to their devices and they do not need to copy notes from the board thus giving them time to participate in the lesson presentation and discussions. Pourciau (2014) expressed that time saving positively affects the learner's results. The use of technological devices during lessons should be consider learner diversity, understanding that each learner has different capabilities.

4.3.6 Innovation and Diversity

When responding to the question: “What are the positive outcomes of integrating smart classrooms in your school?”, most of the participants said that smart classrooms has enable them to be more innovative in the way they deliver their lessons. Participant C2 said:

“Smart classrooms promote diversity in teaching and learning. These boards integrate diverse technology such as microscopes, mobile phones and calculators; thus, they are interactive and provoke active learner participation”.
... *“Some of the learners have found joy in the touch screen and it makes them become more interested in learning”.*

According to Pourciau (2014), smart boards provide an adaptable system to connect teachers with their learners, and the social setting helps to address the diversity of learners. With diverse learners in the same class, lessons can be prepared so that everybody can learn. The class teacher must cater for the learner differences in his or her class. It is crucial for the teacher to choose teaching methods that benefit all learners. Solvie (2013) maintains that individual perspectives help to understand the environment. Teachers need to understand that their personalities and attitudes can impact the lesson flow. Learners come from a variety of socioeconomic backgrounds, and it is the teachers' obligation to adapt their lessons so that every learner can be accommodated. Teachers should be sensitive to learners who may experience learning barriers. Technology can be used to plan appropriate lessons for such learners.

4.4 DOCUMENT ANALYSIS

Document analysis was done according to the checklist (Appendix B). In this analysis focus was on the five schools' ICT files. It is expected that every school that uses smart classrooms must have a policy on ICT integration and implementation in their respective schools. Each school must have a working ICT committee whose members' roles and functions are well spelt out. The following is a summary of the findings.

4.4.1 Schools' ICT Files

The researcher read and studied the content of the schools' ICT files. Four schools had ICT files which were neatly covered and labelled, but the file for school D was exceptional. In these files, all the policies, circulars, memoranda and correspondence on the rollout and implementation of smart classroom are kept. The contents were properly divided, and the information was easily accessible. Even the page numbers were correctly numbered. Some of the findings on documents found in the files that are used in smart classrooms are described below.

4.4.2 ICT policy

ICT policy documents were available in all the five schools' ICT files. The five schools had also their own management policies on integrating technology and policy on implementation of ICT. Although all the five schools had policy documents on ICT, School D was outstanding as it had addressed many items in its policy. For example, there was a management policy on usage of smart boards, use and managing tablets as well as other technological devices. In addition, they included the national policy on e-learning and the White Paper on education. There were also "guidelines on the management and usage of ICTs in public schools in Gauteng".

4.4.3 ICT Committee

All five schools' files identified the ICT committee members and their roles. The ICT Committee is made up of the School Management Team and other staff members, including the ICT coordinator and HoD. Their responsibilities included ICT planning for the school, designing and implementing a plan to improve the school's e-learning, to develop and implement an ICT policy for the school, scheduling and monitoring training of teachers and learners at the school and promoting ICT integration in teaching and learning. Schools A and D had included the contact details of the members.

4.4.4 The ICT Committee's Minutes of Meetings

Of the five schools, four did not hold regular meetings as there were few or no minutes of meetings held as shown by the minutes. At School D, it was evident that regular meetings were held. In these meetings, the school encouraged the use of ICTs for teaching and learning as well as management and administration; provided training for teachers and administrative staff in using ICTs; encouraged using ICTs for lesson preparation and the use of ICTs for lesson delivery; and encouraged teachers to motivate learners to use ICTs during a lesson as part of their learning of a topic. Teachers were requested to evaluate the effectiveness of ICT usage for teaching and the effectiveness of ICT usage for learner progress and provide training for learners.

4.4.5 Contacts for Support

In all five schools, there were contacts for support such as the GDE IT help desk, Mathew Goniwe and Bongani Rainmakers. Matthew Goniwe School of Leadership and Governance is an agency contracted by the GDE. It is responsible for doing research, developing and conducting training in school management and leadership and school governance; conducting teacher training workshops and development for the schools in the Gauteng province.

Bongani Rainmakers is contracted by the GDE to deal with and help in the integration of technology in the province. They are contracted by the GDE to gradual roll out e-learning an integral part of the 4th Industrial Revolution. The organisation will help to transform education and change pedagogy to improve teaching and learning so that learners achieve better and will better equip them for the 21st century world of work, study and living. Bongani Rainmakers has an in-house Ed-Tech department dedicated to the operational execution and support of a true end-to-end e-learning solution. They are responsible for distribution, maintenance and repairs of the technological devices in the smart classrooms.

4.5 NON-PARTICIPANT OBSERVATION

The findings of non-participant observation were based on TPACK theory and other information included on a check list. Lesson observations were done in the classes of all the ten participants. The researcher used a check list (Appendix C) during the non-participant observation sessions. Documents like the lesson plans, the Annual Teaching Programme and the Annual Assessment Plan were also vital during class visits. The following are the findings from the observations done in the 10 teachers' classrooms.

4.5.1 Technological Knowledge

From the observation, five teachers showed a good understanding of the technological devices in their classrooms and they could manipulate the tools with confidence. They were able to select a particular tool that suited the task they were doing, and the learners enjoyed the lessons.

Two participants could use the devices, but they showed lack of confidence in their selection of appropriate tools to suit the activities the class is doing. The learners were partially involved in the lesson activities, but this was restricted to only a few learners in front of their classroom who had a better understanding of the technology. The remaining three participants were still learning where to find the tools suitable for the activities the class would be doing. Learners were even reminding the teachers and helping them to find the features on the smart board. These classes lacked a stimulating learning and teaching environment. A good climate where the teachers had self-confidence and a positive atmosphere that leads to better results were not visible. Rather, a negative climate which included disrespect and disruptive behaviour was evident. Koehler and Mishra (2009) suggest that the learners of today work better using technology and adding technological devices makes learners become more actively involved in the lessons.

TK depicts teachers' learning of, and capacity to use, different technology, technological devices, and related tools (Koehler & Mishra, 2009). TK is the understanding of educational technological devices, thinking about the conceivable outcomes for a branch of knowledge or classroom, figuring out the correct device and how it will help or obstruct learning, and constantly learning and adjusting to new technology (Kurt, 2018).

4.5.2 Technological Content Knowledge

From the observations done, five participants showed that they are well equipped with TCK. Two participants had average-level TCK while three showed little or no TCK. These three were struggling with their lessons. Participant C1 showed that she was knowledgeable on the technological content. During the class visits it was evident that the subject matter was well-organised, and the lesson went well. It was obvious that the teacher had taken time to prepare her lesson and learners took turns to do demonstrations on the smart board. The teacher was able to manipulate the applications on the smart board and was confident when using the smart board throughout the lesson. The inclusion of internet, videos and sound clearly indicated and proved the participant's mastery of TCK. Koehler and Mishra (2009) stress that it is vital for the teachers to continuously update their skills and knowledge of the

components of TPACK which they can employ in their lessons. The participant acknowledged that she was also enjoying her lessons and indeed teaching in general.

Participant D2 had a good command of his lesson. In this lesson, learners were disciplined throughout the entire lesson. The teacher had prepared well for his lesson and was able to use the smart classroom confidently without difficulties. The teacher varied his teaching methods. Teacher explained the subject matter to the learners, and learners could work and engage with each other in groups. Learners had to give feedback on their activities using the smart board with the correct tools. The lesson was well organised, and the teacher showed a high level of TCK as his method suited his content which was more learner-centred and the class could confidently and effectively explore the technology in the class.

In Participant E1's classroom, the atmosphere was conducive to the teaching and learning process. The teacher showed a good command of TCK. She was able to select the appropriate tool that suited the activities in the lesson. In the lesson, there was the use of internet to bring reality to the class. Learners were given clear instructions and support on what they were supposed to do. Learners were given the opportunity to use the smart tools and were able to use it and the learners could also help others who were facing problems to use the gadgets in class.

This depicts teachers' comprehension of how technology can both impact and support content (Kurt, 2018). TCK includes seeing how the topic can be conveyed through the use of various educational technological contributions and thinking about which explicit educational technological instruments may be most appropriate for explicit topics or classrooms (Koehler & Mishra, 2009).

4.5.3 Technological Pedagogical Knowledge

From the findings, five participants demonstrated sound knowledge and confidence in the use of technological devices in their class and lesson activities. They could use and manipulate the tools on the smart board throughout the whole lesson. They were confident in all their activities throughout the lesson. These lessons were structured with clear instructions in which the participants used specific and particular instructional methods to help learners with varied interests and abilities to learn subject

content. They had clear objectives, followed by step-by-step activities that provided targeted feedback and monitoring of learners' understanding of important concepts.

These lessons required active learning and included interactive teaching and learning methodologies which allowed learners to learn according to their own learning styles. By including learners and giving a range of exercises, teachers aim to build learners' self-assurance, basic reasoning and critical thinking abilities (Koehler & Mishra, 2009). These teachers asked questions that provoked learners' thinking and stimulated learners to think critically. Participant A1 asked the following questions,

“Can you explain and demonstrate how to factorise the following expressions.”

“Who can come and solve this equation using factorisation method?”

In Participant B2's lesson, learners were asked probing questions like,

“Explain in your own words how you can curb land pollution if you were the mayor of the town.”

“What are your suggestions on the effects of pollution?”

Teachers can improve their pedagogical techniques by integrating technology in teaching, for instance, to increase learner interaction, when explaining complex content and concepts; to capture learners' attention; to adapt to their teaching to every learners' needs; and to make the teaching and learning process more effective and efficient (Jang & Tsai, 2012).

TPK features the area where technology and instructional method (pedagogy) impact one another. Fusing technology and teaching causes an adjustment in how the material is used (Koehler & Mishra, 2009). A straightforward model may be the point at which a teacher uses an instructional video clip to explain a topic or content that they used to demonstrate on the board. Kurt (2018) affirms that TPK portrays teachers' comprehension of how specific technological devices can change both the educating and learning encounters by presenting new academic content and requirements. He adds that another aspect of TPK concerns seeing how such devices can be selected to improve the order in which concepts are presented.

4.5.4 Transformation and Metamorphosis

This depicts teacher ability to change in the way they carry out their teaching activities so that technology integration can be successful in their classrooms. Kurt (2018) expressed that, for change to be effective, teachers need to understand instructional practices and frameworks that promote effective integration of technology and that are best shaped by content-driven, pedagogically-sound, and technologically forward thinking knowledge.

The findings revealed that six of the participants had well-organised subject matter, there was evidence of lesson preparation in form of daily lesson plans. In the lesson plans, the objectives were clearly stated, and the lesson activities were well arranged and met the scheduled time allowed. The participants also evaluated their lessons, emphasising and summarising the main points of the lesson. For example, Participant D1 concluded her lesson while illustrating on the board in a table form, as follows:

“To sum up the difference between private and public sectors businesses are, public are state owned and are run by the government, and private are owned by entrepreneurs or individuals.”

Table 4.2: The difference between public and private sector business

PUBLIC	PRIVATE
State owned	Private owned
State-run (parastatals)	Individual or entrepreneurs
Non-profit organisation	Profit-driven organisations

Table 4.2 Illustrates how the participant D1 used a smart board and smart tools to compare the public and private businesses. The participant was able to present the lesson using smart tools to draw the above Table 4.2.

There was evidence that the School Management Team regularly monitored the progress of their educators. It was evident that these six participants were well geared for the transformation of education to meet the demands of the new digital world.

With regard to the other four participants, two did not have proper lesson plans and their teacher files were not up to the expected standard while the other two refused to give the researcher their preparation files stating that the researcher did not have

authority to peruse their files. It was this that led the researcher to conclude that these teachers went to their classes unprepared and that is why they were struggling in their lesson delivery. This attitude may be caused by resistance to change.

Participant E1 showed much concern about the different teachers' attitudes towards accepting change, when she said:

“Some teachers are adamant not to change due to their own beliefs, and there are some teachers who do not just want change without any apparent reason.”

Nagel (2014) explained that, resistance to innovation comes in numerous forms, yet one of the key challenges recognised in the report is the comfort with business as usual. According to Nagel (2010), teachers and school leaders regularly observe experimentation with new systems of teaching as outside the extent of what should be expected from them. Most of the teachers who were BBT were reluctant to embrace the use of smart boards. They lacked self-motivation and technological skills. Most of these teachers were wedded to the chalkboard and could not let it go. Thus, this will impact negatively on the implementation of smart classrooms.

4.6 CONCLUSION

Chapter 4 covered presentation, analysis and discussion of findings. The chapter analysed the information gathered from the semi-structured interviews, interview transcripts, lesson observation checklists, documentation analysis and all the data recorded from the participants. The findings in the chapter gave a better understanding of the pedagogical impact of smart classrooms on teaching and learning of Grade 11 in the Tshwane South District. The data collected from all the participants in this investigation were used by the researcher for the summary, conclusions and recommendations of the entire study.

CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

This chapter starts by elaborating on what is included in all chapters from chapter 1 to Chapter 4. Then it proceeds with a summary of the findings of the entire investigation, followed by a discussion of the limitations of the investigation. The conclusions based on the objectives are then presented. The researcher makes some broad proposals and recommendations based on the findings and could be used in future related investigations.

5.2 SUMMARY OF THE THESIS

Chapter 1 identified the phenomenon that this study sought to address and explore, and the background of the study was discussed. The rationale for the investigation was articulated. In this chapter the researcher identified the problem statement which led to the identification of the research question which was to investigate the pedagogical impact of smart classrooms used by teachers in teaching and learning of Grade 11 learners in the Tshwane South District. Sub-questions emanated from this to help to address the main question. The aim and objectives of the study were given in this chapter. The research paradigm and the methodology were briefly explored, which included a discussion on the population, sampling and data collection methods to be deployed. A brief discussion of data analysis and interpretation was done in this chapter. Measures to ensure the trustworthiness of the study, ethical considerations, limitations and delimitations of the study were addressed and the key terms were defined.

Chapter 2 presented a literature review on the use of the smart classroom and its implications for teaching and learning. The related literature on the pedagogical impact of smart classrooms in teaching and learning was discussed. The introduction and impact of smart classrooms in other countries where smart technology was commissioned before being introduced in South Africa was also examined in Chapter 2. TPACK, the theoretical framework on which the study was based, was explored. The chapter ended with an analysis of the benefits and challenges faced by teachers when using the smart classroom.

Chapter 3 discussed the methodology used when conducting this study. The researcher detailed the paradigmatic perspective and research methodology and design for the study and justifications for the sampling techniques that were followed when selecting the population and samples of the study were provided. The techniques and procedures used to collect and analyse the data of were discussed in this chapter. At the end of the chapter, measures to ensure trustworthiness and ethical considerations that were followed during the study, were examined.

Chapter 4 presented the data analysis and discussion of findings. Ten teachers were selected. Two participants from five secondary schools were interviewed using individual semi-structured interview questions (Appendix A) from which themes emerged. Non-participant observation was done in each participant's classroom using a checklist (Appendix B) and a document analysis of the ICT files was conducted using a checklist (Appendix C). The themes that emerged from the data gathered and analysed were also discussed. The findings in Chapter 4 provided a good understanding of the pedagogical impact of smart classrooms on teaching and learning of Grade 11 learners in the Tshwane South District.

5.3 SUMMARY OF THE FINDINGS

This study was conducted in five secondary schools in Tshwane South District. The research endeavoured to investigate the pedagogical impact of smart classrooms on teaching and learning of Grade 11 learners in the Tshwane South District. The topic was selected because the GDE introduced smart classrooms in Grade 11 and 12 in most of the schools. So, the researcher wanted to establish the impact this introduction had on pedagogy. The researcher selected the Tshwane South District where he picked five schools basing on the fact that the schools used smart classrooms, focussing on Grade 11 teachers. Two teachers from each school were interviewed and a lesson observation was conducted with each teacher. The ICT files for each school were also analysed. From all the findings, it was evident that the use of smart classrooms in teaching and learning has created a paradigm shift from the traditional mode of teaching and learning in schools. The findings of this study answered the main research question and the sub-questions in the following way.

5.3.1 Summary of Findings from Semi-Structured Interviews

The findings of the semi-structured interview reflect that the participants of this study are using smart technology in their daily teaching processes. The findings revealed that smart technology is useful, important and effective in the teaching and learning process. Despite the identified challenges in using the new technology in learning, the participants described it as user-friendly.

Some of the positive impacts smart classrooms have brought to education in their schools are as follows:

- Smart classrooms have created an environment that is conducive to learning and it caters for all learners' learning needs and difficulties.
- The integration of smart technology in education has created an environment which will make learner keen to learn.
- Smart classrooms have helped the modern class to be more conducive to learning using audio and visual aids.
- Learners are now enjoying coming to lessons as the environment created in the new classroom suits their needs, and they enjoy using technology. Thus, attendance and participation have greatly improved in some of these schools.

The findings concerning the introduction of smart classrooms at the selected schools were that it was received positively by the teachers, with everyone eager to know how the new technology would help them to improve their daily classroom practices. The findings revealed that smart classrooms have the following advantages when it comes to pedagogy:

- Smart classrooms have made teachers' life and teaching easy as the system is conducive to a variety of teaching methods.
- Smart boards are wide enough for all learners to see regardless where they sit in the class, and the teacher can enlarge texts as well as images so that everyone can easily see clearly.
- Due to its clarity and when connected to internet, it has brought reality in classrooms because of the variety of media that can be accessed.

Moreover, the findings have shown that teachers felt positive about the use of smart classrooms when teaching and learning. They all accepted and voiced that the introduction and integration of smart classrooms into all subjects at school had brought a branch of knowledge into educational practice that had become a new pedagogy that seeks to transform the teaching and learning process as teachers now needed to be technologically advanced. They agreed that they should be trained to use smart technology devices during the teaching and learning processes at their schools.

The findings revealed that the smart classroom saves times make teaching enjoyable. All the lesson plans are loaded on the smart board. E-Textbooks and resources are loaded on the smart board which makes the work easy as there is less time spent in planning the lessons. The other way in which time is saved is using presentations. One presentation can be used in all the classes rather than on the chalkboard, each time, from one period to the other. Teachers can use online resources from a wide range of educational sites that are found on the internet. There are a lot of presentations that can be useful when teaching and learning. Teacher can download educational games such as quizzes and puzzles on certain topics that provoke critical thinking in learners.

The use of smart boards helps teachers to cover a lot of content in a short space of time. Teachers must be in a position to choose which method best fits the particular content they are teaching.

5.3.2 Summary of Findings from Document Analysis

All five schools had an ICT file and the contents were spelt out clearly. Every school had policy on ICT integration and implementation. ICT committee members as well as each members' roles and functions were well spelt out. In these files, all the policies, circulars, memoranda and correspondence pertaining to the roll out and implementation of smart classroom were filed. There was a management policy on usage of smart boards, use and managing tablets as well as other technological devices. The national policy on e-learning and the White Paper on education as well as guidelines on the management and usage of ICTs in public schools in Gauteng were included.

There was evidence of regular meetings held shown by the minutes filed. In these meetings, they encouraged the use of ICTs for teaching and learning. Details of support or contacts of GDE IT helpdesk were included in some ICT files. There were also details of other service providers like Mathew Goniwe and Bongani Rainmakers in the files.

Despite the positive impacts smart classrooms have brought to education, there were some challenges faced by educators while trying to implement the new systems in their schools.

5.3.3 Summary of Findings from Non-Participant Observation

Participants showed varied mastery of TK. Some were well conversant with navigation of the smart board. They could manipulate with the tools on the smart board throughout the lessons. The others were operating on average while others struggled in their lessons.

With regard to TCK, some participants showed that they are equipped with the TCK as they showed confidence in delivering content. Most of the participants during the class visits demonstrated mastery of the subject matter and the lesson was presented well. It was evident that the participants had taken time to prepare their lessons. They navigated the smart board well and were confident when using the smart board throughout the lessons. The inclusion of the internet, videos and sound clearly indicated and proved the participant's mastery of the technology.

Some participants demonstrated better TPK, as they showed knowledge and confidence in the use of technological devices in their class and lesson activities. They could use and manipulate the tools on the smart board throughout the lessons and used specific and particular instructional methods to help learners with varied interests and abilities to learn subject content. The participants varied their methods and learners gave feedback of their activities using the smart board with correct tools. But other participants were operating at an average staged while some showed little or no TCK as were struggling with their lessons.

There was active learning that included interactive teaching methodology that involved learners in their own learning environments, with effective teachers aiming to stimulate learners' self-confidence, critical thinking and problem-solving skills.

The other participants could use the devices but showed lack of confidence in their selection of appropriate tools to suit the activities the class is doing. These participants lacked TK in some instances helped them to navigate the smart board. Therefore, for effective and better implementation of smart classrooms, there is need for proper training and workshopping of the teachers to gain the skills needed when using smart technology. There is need for all stakeholders to be well informed about the importance of smart technology in education today.

Smart technologies serve as an aid in the implementation of new and changing teaching methods. Teacher contributions with smart technology have moved from learning how to utilise smart technology to looking for new approaches to enhance learning with technology. The teachers agreed that smart classrooms have a greater positive impact on pedagogy, thus there is need for training of the all teachers as success is pinned on the teachers' achievements, and there should be measurable objectives and policy for implementation and proper sustainability of these smart classrooms.

5.3.4 Summary of the Challenges

There is a high cost in purchasing and running smart classrooms as they are expensive to buy and maintain. It is affordable to former model 'C' schools as they charge higher amounts of school fees and levies. These were the sentiments of some of the participants. They said that to buy the screen, projector and printers as well as to get money to refill the cartridges time and again was not always easy. The cost of paying the highly trained technicians for technical support was another cost which most of the schools could not afford.

The other challenge is a lack of sufficient professional development and training for the teachers. Participants emphasised that the key to effective utilisation and proper implementation of smart classrooms depended on what type of training was provided to teachers. The teachers did not receive proper training but workshops where even the trainers seemed not to be equipped with the skills. Key among all difficulties is the absence of sufficient, continuous professional development for teachers who are required to incorporate new advances into their classrooms yet who are ill-equipped or unwilling to adopt innovations. Some teachers lacked the technical knowhow to use to this new technology. They were not well equipped with skills to operate the new

system. No proper training was done with the implementers of the programme. Teachers lacked the skills and proper knowledge on how to present their lessons using technology. This may lead to underutilisation of the technology.

Resistance to change was another hindering factor. Participants showed concern about the different teachers' attitudes towards accepting change, due to their own beliefs and there were some who did not want change. Most of the teachers who were BBT were reluctant to embrace the use of smart boards. Most lack self-motivation and skills. Most of these teachers wanted to continue using the chalk board. Thus, this will impact negatively on the implementation of smart classrooms.

Another problem is that, electronic devices are prone to technical faults. Some participants said that the major hurdle they were facing was the technical support for the smart boards. Problems could happen in the middle of a lesson and this could impact on the enthusiasm of learners. Teacher sometimes needed to abandon the lesson to look for a technician if there was one at the school. Continuous power supply was another problem that needed to be overcome.

5.4 LIMITATIONS OF THE STUDY

The findings and results analysed were derived from only five secondary schools in the Tshwane South District. The researcher encountered a problem during the study when an interview was cancelled twice due to circumstances beyond his control. The interview was later done after the third appointment.

The population or sample size of the study was small which limited the possible ability to say whether other schools experienced similar problems.

The research did not include the views and perceptions of the learners, HoDs, senior management and administrators of the schools, or of all other affected and interested parties, but was limited to teachers only. As a result, the outcomes of the study did not include the perceptions and views of other stakeholders regarding the introduction and the implementation of smart classrooms.

5.5 RECOMMENDATIONS

5.5.1 Recommendations for the Gauteng Department of Education

The GDE should

- Institute training on effective methods of teaching using smart technology in schools.
- Arrange for continuous workshops done by fully trained technicians who are knowledgeable about the new smart technology devices in schools.

5.5.2 Recommendations for Teachers

- Teachers need to be well informed about their role in the integration of smart technology in education. It is a strategy that will transform education and change pedagogy to improve teaching and learning so that learners achieve better, thus teachers need to be also better equipped for the 21st-century world of work, education and living.
- Teachers should be urged to take part in staff developmental and learning programmes that will help them with their pedagogical challenges which they may face when using smart technology.
- Teachers need to be acquainted with all policies and legislation that govern the introduction and implementation of smart classrooms.
- Teachers must be well trained and skilled as they are key to the implementation of this programme.

5.6 REFLECTIONS ON THE RESEARCH

This investigation gave me a profitable encounter through my interaction with the school managers (principals), and teachers using smart classrooms, while sharing their encounters, perceptions, convictions and attitudes on the difficulties experienced in integrating technology into the educating and learning exercises. I built up a better understanding of the challenges that influence schools and how teachers and learners attempt to incorporate smart technology into their teaching and learning exercises. Lastly, I also learnt new pedagogy through interaction with the participants in this study and realised how important the smart classrooms are in developing education in this country.

5.7 RECOMMENDATIONS FOR FURTHER RESEARCH

Further study is required on same problem that may probably use more schools and teachers in the data collection so as to gather substantial evidence to use to reach a well-informed conclusion.

The GDE should institute a study on the effective implementation of smart classrooms by teachers and management of smart classrooms by school principals and ICT coordinators.

5.8 CONCLUSION

The purpose of this investigation was to investigate the pedagogical impact of smart classrooms in teaching and learning of Grade 11 in the Tshwane South District. The aims of the entire study were was to investigate how Grade 11 secondary school teachers used smart classrooms to enhance their teaching and learning; to determine the support Grade 11 secondary school teachers had concerning the use of these smart classrooms; and to identify challenges faced by Grade 11 teachers when using smart classrooms for teaching and learning in selected secondary schools in Tshwane South District.

This study revealed the following:

- The introduction of smart classrooms in the Tshwane South District has both positive and negative impacts on the teaching and learning process in schools though the positive outnumbered the negative impacts.
- Teachers enjoy teaching using smart classrooms and it is evident that smart classrooms have changed their pedagogy.
- Teachers' levels of competency can be improved through proper training and workshopping to acquire the necessary skills to use the technology.
- The GDE needs to look into how they respond to calls logged in terms of technical faults as it is a challenge to the implementation of smart classrooms.

Pushing ahead, it is fundamental that the GDE tends to the challenges and concerns of the teachers. The difficulties that teachers experience can prompt dissatisfaction which can thus lead negative impact on teaching and learning.

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APPENDICES

APPENDIX A: TEACHERS' INTERVIEW GUIDE

Teacher Interview Questions

1. For how long have you been teaching?
2. How often do you use the smart classrooms?
3. Did you receive training on the use of smart classrooms?
4. Do you use smart technology to teach, to plan lessons, to keep records and to communicate? Elaborate
5. For what topics in your subject do you often use the smart board to teach? Elaborate
6. What is your experience of using smart classrooms in teaching and learning?
7. Does the use of smart classrooms improve learners' performance?
8. What challenges do you meet when using smart classrooms?
9. What kind of support do you receive from your colleagues in terms of the use of smart classrooms? Elaborate
10. How do you solve technical problems when using smart classrooms?
11. Do you think the introduction of smart classrooms is critical to education now?
12. What are the positive outcomes of integrating smart classrooms in your school?
13. What are the negative outcomes in terms of teaching, learning and discipline?
14. Do you think the integration of these smart classrooms is a sustainable?
15. What do you think can be done to improve the implementation of smart technology in schools?

APPENDIX B: DOCUMENT ANALYSIS CHECKLIST

Participant: _____

Date and Time _____

Item	Comments
1. ICT FILE (Does the school have an ICT file)	
1.1 ICT POLICY DOCUMENT (Availability of the ICT policy in the file, any information about the use of smart classroom)	
1.2. ICT COMMITTEE (The ICT committee members are listed in the ICT file)	
1.3 THE ICT COMMITTEE MINUTE OF MEETING (Are there minutes of meeting filed and how often do they meet, any information about the use of smart classroom)	
2. CONTACTS OF SUPPORT (Availability of details of support or GDE IT helpdesk.)	
3. ANY OTHER DOCUMENTS (Are there any other documents that are vital to the study in the file)	

APPENDIX C: LESSON NON-PARTICIPANT OBSERVATION CHECKLIST

Participant: _____ Date and Time _____

Room No. _____

Item	
TECHNOLOGICAL KNOWLEDGE (The choice of an appropriate tool for delivery of a lesson)	
TECHNOLOGICAL PEDAGOGICAL KNOWLEDGE (teaching method)	
TECHNOLOGICAL CONTENT KNOWLEDGE (shows good command and demonstrates breadth and depth of technological content knowledge)	
TRANSFORMATION (organises subject matter; evidences preparation; is thorough; states clear objectives; emphasises and summarises main points, meets class at scheduled time, regularly monitors online course)	
PRESENTATION (classroom environment conducive to learning; maintains eye contact; uses a clear instructions)	
LEARNERS' ACTIVITIES (learners' use technology in the classroom during the lesson)	
TEACHERS' ACTIVITIES (evidences self-confidence in using technology)	

APPENDIX D: ETHICS APPROVAL FORM

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2018/08/15

Dear Mr Mugani

Decision: Ethics Approval form
2018/08/15 to 2021/08/15

Ref: 2018/08/ 15/56477694/31
/MC

Name: Mr P Mugani

Student: 56477694

Researcher(s): Name: Mr P Mugani

Email address: paradzayimugani@yahoo.com Telephone:
+27 71 240 2928

Supervisor(s): Name: Dr AR Molotsi

Email address: molotar@unisa.ac.za
Telephone: +27 12 429 3265

Title of research:

The pedagogical impact of smart classrooms on teaching and learning of Grade 11 in Tshwane South
District

Qualification: M. Ed in Curriculum and Instructional Studies

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above-mentioned research. Ethics approval is granted for the period 2018/08/15 to 2021/08/15.

The low risk application was reviewed by the Ethics Review Committee on 2018/08/15 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.

University of South Africa

Preller Street. Muckleneuk Ridge. City of Tshwane

PO Box 392 UNISA 0003 South

Africa +27 1 2 429 3 1 'i l

Facsimile: +27 12 429 4150

www.unisa.ac.za



The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following
6. South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date 2021/08/15. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number 2018/08/15/56477694/ 31/ MC should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.

Kind regards,



Dr M Claassens

CHAIRPERSON: CEDU

mcdtc@netactive.co.za

University of South Africa
Preller St eet. Muckleneuk Ridge. City of Tshwane
PO Box 392 UNISA 0003 South Africa



Prof V McKay

RERC EXECUTIVE DEAN

Mckayvi@unisa.ac.za

Telephone: +27 12 429 31 1 1
Facsimile: +27 1 2 429 4150
www.unisa.ac.za

APPENDIX E: GDE RESEARCH APPROVAL LETTER



GAUTENG PROVINCE
 Department: Education
 REPUBLIC OF SOUTH AFRICA

814141112

Date:	04 September 2018
Validity of Research Approval:	05 February 2018 - 28 September 2018 2018/284
Name of Researcher:	Mugani P.
Address of Researcher:	15 Spelter Terrace
	West Park
	Pretoria, 0183
Telephone Number:	083 517 2784 084 278 3981
Email address:	paradzayimugani@yahoo.com
Research Topic:	The Pedagogical Impact of Smart Classrooms on Teaching and Learning of Grade 11 in Tshwane South District.
Type of qualification	M.Ed. in Science and Technology Education
Number and type of schools:	Five Secondary Schools.
District/s/HO	Tshwane South

Re: Approval in Respect of Request to Conduct Research

This letter serves to indicate that approval is hereby granted to the above-mentioned researcher to proceed with research in respect of the study indicated above. The onus rests with the researcher to negotiate appropriate and relevant time schedules with the school/s and/or offices involved to conduct the research. A separate copy of this letter must be presented to both the School (both Principal and SGB) and the District/Head Office Senior Manager confirming that permission has been granted for the research to be conducted.

The following conditions apply to GDE research. The researcher may proceed with the above study subject to the conditions listed below being met. Approval may be withdrawn should any of the condition listed below be flouted:

Kind regards



.....

04/09/2018
.....

Making education a societal priority

Office of the Director: Education Research and Knowledge Management

7th Floor, 17 Simmonds Street, Johannesburg, 2001

-re': (01 1) 355 0488

Email: Faith.Tshabalala@gauteng.gov.za

Website: www.education.gpg.gov.za

1. The District/Head Office Senior Manager/s concerned must be presented with a copy of this letter that would indicate that the said researcher/s has/have been granted permission from the Gauteng Department of Education to conduct the research study.
2. The District/Head Office Senior Manager/s must be approached separately, and in writing, for permission to involve District/Head Office Officials in the project.
3. A copy of this letter must be forwarded to the school principal and the chairperson of the School Governing Body (SGB) that would indicate that the researcher/s have been granted permission from the Gauteng Department of Education to conduct the research study.
4. A letter/ document that outline the purpose of the research and the anticipated outcomes of such research must be made available to the principals, SGBs and District/Head Office Senior Managers of the schools and districts/offices concerned, respectively.
5. The researcher will make every effort obtain the goodwill and co-operation of all the GDE officials, principals, and chairpersons of the SGBs, teachers and learners involved. Persons who offer their co-operation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
6. Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal (if at a school) and/or Director (if at a district/head office) must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.
7. Research may only commence from the second week of February and must be concluded before the beginning of the last quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.
8. Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.
9. It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.

10. The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institutions and/or the offices visited for supplying such resources.
11. The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research report without the written consent of each of these individuals and/or organisations.
12. On completion of the study the researcher/s must supply the Director: Knowledge Management & Research with one Hard Cover bound and an electronic copy of the research.
13. The researcher may be expected to provide shown presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned.
14. Should the researcher have been involved with research at a school and/or a district/head office level, the Director concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

The Gauteng Department of Education wishes you well in this important undertaking and looks forward to examining the findings of your research study.

Kind regards




Mr Gurnani Mukatuni

Acting CES: Education Research and Knowledge Management

DATE: 04/09/2018

2

 Making education a societal priority

Office of the Director: Education Research and Knowledge
Management

7th Floor, 17 Simmonds Street, Johannesburg, 2001

Tel: (011) 355 0488

Email: Faith.Tshabalala@gauteng.gov.za Website: www.education.gpg.gov.za

**APPENDIX F: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN
TSHWANE SOUTH DISTRICT**

**THE PEDAGOGICAL IMPACT OF SMART CLASSROOMS ON TEACHING AND
LEARNING OF GRADE 11 IN TSHWANE SOUTH.**

11 May 2018

Deputy Chief Education Specialist

Department of policy and planning

Tel no: (012) 401 6326

email: Sello.Ngwenya@gauteng.gov.za

Dear: Mr Sello Ngwenya

I, Paradzayi Mugani am doing research under the supervision of Doctor AR. Molotsi, a senior Lecturer in the Department of Science and Technology at University of South Africa. I am a registered Masters' degree student in Education.

The aim of my study is to explore the pedagogical impact of smart classrooms on teaching and learning of Grade 11 in Tshwane South District. Tshwane South has been selected because it is one of the districts where Smart classrooms are installed, which makes it key in this study.

The study will entail the interviewing of teachers, a lesson observation and analysing documents in five selected secondary schools. Interviews will take place on site at the schools after necessary consent forms have been signed. The dates and times will be discussed with the principals of the schools to cause minimum classroom disruptions in the school day.

The results of the study will assist the government in realising the importance and impact of the smart classrooms to improve the teaching and learning in schools. The results will help with the evaluation of the implementation of the programme in the schools.

There are no potential risks, physically or otherwise, involved in this research as the topic is non-sensitive. Participation will be voluntary and participants' identities will be

kept confidential and anonymous. Participants will or have the choice to be withdraw from the study without any penalty. There shall be no reimbursement or any incentives for participation in the research.

Feedback procedure will entail participants contacting the supervisor or researcher of this study for the outcome of the research. The researcher will provide contact details to them.

Yours sincerely

The image shows two handwritten signatures. The first signature on the left is written in cursive and appears to be 'Paradzayi Mugani', with a horizontal line underneath it. The second signature on the right is also in cursive and appears to be 'AR Molotsi'.

Paradzayi Mugani (M.Ed. Student) Dr AR Molotsi (Supervisor)

071 240 2928 012 429 3265

paradzayimugani@yahoo.com molotar@unisa.ac.za

**APPENDIX G: LETTER TO PRINCIPALS OF SCHOOLS REQUESTING
PERMISSION TO CONDUCT RESEARCH**

Request for permission to conduct research at

Secondary School

**TITLE OF THE RESEARCH: THE PEDAGOGICAL IMPACT OF SMART
CLASSROOMS ON TEACHING AND LEARNING OF GRADE 11 CLASSROOMS IN
TSHWANE SOUTH.**

11 May 2018

The Principal

Secondary school

Dear Sir

I, Paradzayi Mugani am doing research under the supervision of Doctor AR Molotsi, a senior Lecturer in the Department of Science and Technology at University of South Africa. I am a registered Masters' degree student in Education.

The aim of my study is to explore the pedagogical impact of smart classrooms on teaching and learning of Grade 11 in Tshwane South District. Tshwane South has been selected because it is one of the districts where Smart classrooms are installed, which makes it key in this study.

The study will entail the interviewing of teachers, a lesson observation and analysing documents in five selected secondary schools. Interviews will take place on site at the schools after necessary consent forms have been signed. The dates and times will be discussed with the principals of the schools to cause minimum classroom disruptions in the school day.

The results of the study will assist the government in realising the importance and impact of the smart classrooms to improve the teaching and learning in schools. The results will help with the evaluation of the implementation of the programme in the schools.

There are no potential risks, physically or otherwise, involved in this research as the topic is non-sensitive. Participation will be voluntary and participants' identities will be kept confidential and anonymous. Participants will or have the choice to be withdraw from the study without any penalty. There shall be no reimbursement or any incentives for participation in the research.

Feedback procedure will entail participants contacting the supervisor or researcher of this study for the outcome of the research. The researcher will provide contact details to them.

Yours sincerely

The image shows two handwritten signatures. The first signature, on the left, is written in black ink and appears to be 'Paradzayi Mugani'. The second signature, on the right, is written in blue ink and appears to be 'Dr AR Molotsi'. Both signatures are written over a horizontal line.

Paradzayi Mugani (M.Ed. Student) Dr AR Molotsi (Supervisor)

071 240 2928 012 429 3265

paradzayimugani@yahoo.com molotar@unisa.ac.za

APPENDIX H: LETTER OF REQUEST FOR PARTICIPANTS

DEAR PROSPECTIVE PARTICIPANT

My name is Paradzayi Mugani and I am conducting research under the supervision of Dr. AR Molotsi, a senior lecturer in the Department of Science and Technology Education, towards a Master's Degree in Education. The study is entitled, THE PEDAGOGICAL IMPACT OF SMART CLASSROOMS ON TEACHING AND LEARNING OF GRADE 11 LEARNERS IN TSHWANE SOUTH DISTRICT. Permission for conducting the study has been granted by College of Education.

You are invited to participate in the study entitled, the pedagogical impact of smart classrooms on teaching and learning Grade 11 learners in Tshwane South District. I have selected five secondary schools in the district where I will interview two teachers per school using smart classrooms when teaching.

I will provide you with more information about this study and your involvement. The importance and the impact of smart classrooms in learning and teaching is a very relevant situation in education, in South Africa. In this study, I will request your views and opinions on the topic. This information may be used to improve the quality education by improving the pedagogy of the teachers.

The study will involve an interview of approximately 30 minutes in length in a mutually agreed location and time convenient to you. This will be followed by a classroom observation. I would also like to have a look on your lesson planning file if possible. You may decline to answer any of the interview questions if you wish. Participating in this study is voluntary and you are under no obligation to consent to participation. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a written consent form. You are free to withdraw at any time and without giving a reason. Your name will not be recorded anywhere and no one will be able to connect you to the answers you give. Your answers will be given a code number or a pseudonym and you will be referred to in this way in the data, any publications, or other research reporting methods such as conference proceedings

With your kind permission, the interview will be audio-recorded to facilitate collection of accurate information and later transcribed for analysis. Shortly after the transcription has been completed, I will send you a copy of the transcript to give you an opportunity to confirm the accuracy of your conversation and to add or to clarify any points. All information you provide is considered completely confidential. Your name will not appear in any publication resulting from this study and any identifying information will be omitted from the report. However, with your permission, anonymous quotations may be used. Data collection during this study will be retained on a password protected computer for 5 years in my locked office.

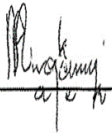
The benefits of this study are to highlight the **pedagogical impact** of smart classrooms on teaching and learning of Grade 11 and there are no known or anticipated risks to you as a participant in this study. You will not be reimbursed or receive any incentives for your participation in the research.

If you would like to be informed of the final research findings, or Should you have concerns about the way in which the research has been conducted, you may please contact Dr. A. Molotsi 012 429 3265 or email on molotar@unisa.ac.za.

If you have any questions regarding this study, or would like additional information to assist you in reaching a decision about participation, please contact me on 071 240 2928 or by email on paradzayimugani@yahoo.com.

Thank you for taking time to read this information sheet and for participating in this study.

Thank you.



A handwritten signature in black ink, appearing to read 'Paradzayi Mugani', is written above a solid horizontal line.

PARADZAYI MUGANI Signature :

Date signed : 09/05/2018

APPENDIX I: CONSENT FORM

I, _____ (**participant name**), confirm that the person asking my consent to take part in this research has told me about the nature, procedure, potential benefits and anticipated inconvenience of participation.

I have read (or had explained to me) and understood the study as explained in the information sheet.

I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty.

I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified.

I agree to the recording of the interview.

I have received a signed copy of the informed consent agreement

Participant's Name (Please print): _____

Participant Signature: _____

Researcher's Name (Please print): Paradzayi Mugani

Researcher's Signature:  _____

Date: 09/05/2018

APPENDIX J: GDE APPLICATION FORM



GAUTENG PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

For adminuse only:

Ref. no.:
Enquiries 0113550775
Gumani Mukatuni

GDE RESEARCH REQUEST FORM

REQUEST TO CONDUCT RESEARCH IN INSTITUTIONS AND/OR OFFICES OF THE GAUTENG DEPARTMENT OF EDUCATION

1. PARTICULARS OF THE RESEARCHER

1.1	Details of the Researcher	
	<i>Surname and Initials:</i>	MUGANI. P
	<i>First Name/s:</i>	PARADZAYI
	<i>Title (Prof / Dr / Mr / Mrs / Ms):</i>	MR
	<i>Student Number (if relevant):</i>	56477694
	<i>SA ID Number:</i>	7605225867182
	<i>Work permit no. (If not SA citizen)</i>	N/A

1.2	Private Contact Details	
	<i>Home Address</i>	<i>Postal Address (if different)</i>
	15 SPELTER TERRACE	15 SPELTER TERRACE
	WEST PARK	WEST PARK
	PRETORIA	PRETORIA
	<i>Postal Code: 0183</i>	<i>Postal Code: 0183</i>
	<i>Tel: 084 278 3981</i>	<i>Cell: 071 240 2928</i>
	<i>Fax: 012 374 7907</i>	<i>Email: paradzayimugani@yahoo.com</i>

2. PURPOSE & DETAILS OF THE PROPOSED RESEARCH

2.1	Purpose of the Research (Place cross where appropriate)	
	<i>Undergraduate Study - Self</i>	
	<i>Postgraduate Study - Self</i>	×
	<i>Private Company/Agency – Commissioned by Provincial Government or Department</i>	
	<i>Private Research by Independent Researcher</i>	
	<i>Non-Governmental Organisation</i>	
	<i>National Department of Education</i>	
	<i>Commissions and Committees</i>	
	<i>Independent Research Agencies</i>	
	<i>Statutory Research Agencies</i>	
	<i>Higher Education Institutions only</i>	

2.2	Full title of Thesis / Dissertation / Research Project	
THE PEDAGOGICAL IMPACT OF SMART CLASSROOMS ON TEACHING AND LEARNING OF GRADE 11 IN TSHWANE SOUTH DISTRICT		
2.3	Value of the Research to Education (Attach Research Proposal)	
The knowledge to be established in this study is intended to build on existing knowledge about the pedagogical impact of smart classrooms in teaching and learning. The study will promote awareness of smart classrooms (ICT) on teaching and learning in South Africa.		
2.4		Date
Envisaged date of completion of research in GDE Institutions		15/09/2018
Envisaged date of submission of Research Report and Research Summary to GDE:		31/01/2019
2.5	Student and Postgraduate Enrolment Particulars	
Name of institution where enrolled:		UNISA
Degree / Qualification:		M.Ed. in Science and Technology Education
Faculty and Discipline / Area of Study:		Science and Technology Education- ICT in Education
Name of Supervisor / Promoter:		Dr AR Molotsi

2.6	Employer	
Name of Organisation:		GAUTENG DEPARTMENT OF EDUCATION- HIMALAYA SECONDARY SCHOOL
Position in Organisation:		TEACHER
Head of Organisation:		MR V. PADYACHY
Street Address:		CNR BENGAL AND 37 TH AVENUE LAUDIUM. PRETORIA
Postal Code:		0037
Telephone Number (Code + Ext):		012 374 2760
Fax Number:		012 374 7907
Email:		Himalaya700230037@gmail.com

2.7	PERSAL Number (GDE employees only)	
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2	2	9	6	3	2	1	9
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3. PROPOSED RESEARCH METHOD/S

(Please indicate by placing a cross in the appropriate block whether the following modes would be adopted)

3.1 Questionnaire/s (If Yes, supply copies of each to be used)	YES		NO	X
3.2 Interview/s (If Yes, provide copies of each schedule)	YES	X	NO	
3.3 Use of official documents	YES	X	NO	
If Yes, please specify the document/s:	ICT files and educators' files			
3.4 Workshop/s / Group Discussions (If Yes, Supply details)	YES		NO	X
3.5 Standardised Tests (e.g. Psychometric Tests)	YES		NO	X
If Yes, please specify the test/s to be used and provide a copy/ies				

1. INSTITUTIONS TO BE INVOLVED IN THE RESEARCH

4.1 *Type and Number of Institutions (Please indicate by placing a cross alongside all types of institutions to be researched)*

INSTITUTIONS	Write NUMBER here
<i>Primary Schools</i>	N/A
<i>Secondary Schools</i>	5
<i>ABET Centres</i>	N/A
<i>ECD Sites</i>	N/A
<i>LSEN Schools</i>	N/A
<i>Further Education & Training Institutions</i>	N/A
<i>Districts and / or Head Office</i>	N/A

4.2 Name/s of institutions to be researched (Please complete on a separate sheet if space is found to be insufficient)

Name/s of Institution/s
<i>School A Secondary School</i>
<i>School B Secondary School</i>
<i>School C Secondary School</i>
<i>School D Secondary School</i>
<i>School E Secondary School</i>

4.3 District/s where the study is to be conducted. (Please indicate by placing a cross alongside the relevant district/s)

District/s			
<i>Ekurhuleni North</i>		<i>Ekurhuleni South</i>	
<i>Gauteng East</i>		<i>Gauteng North</i>	
<i>Gauteng West</i>		<i>Johannesburg Central</i>	
<i>Johannesburg East</i>		<i>Johannesburg North</i>	
<i>Johannesburg South</i>		<i>Johannesburg West</i>	
<i>Sedibeng East</i>		<i>Sedibeng West</i>	
<i>Tshwane North</i>		<i>Tshwane-South</i>	x
<i>Tshwane West</i>			

If Head Office/s (Please indicate Directorate/s)
N/A

4.4 Number of learners to be involved per school (Please indicate the number by gender)

Grade		1	2		3		4		5		6		
Gender	B	G	B	G	B	G	B		G	B	G	B	G
Number	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Grade	7		8		9		10		11		12	
Gender	B	G	B	G	B	G	B	G	B	G	B	G
Number	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

4.5 Number of educators/officials involved in the study (Please indicate the number in the relevant column)

Type of staff	Educators	HoDs	Deputy Principals	Principal	Lecturers	Office Based Officials
Number	10	0	0	0	0	0

4.6 Are the participants to be involved in groups or individually?

Groups		Individually	x
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4.7 Average period of time each participant will be involved in the test or other research activities (Please indicate time in minutes)

Participant/s	Activity	Time
TEACHERS	INTERVIEW	30 MINUTES

4.8 Time of day that you propose to conduct your research.

During school hours (for <u>limited</u> observation only)	x	After School Hours	x
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4.9 School Term/S During Which The Research Would Be Undertaken

First Term		Second Term		Third Term	x
------------	--	-------------	--	------------	---

CONDITIONS FOR CONDUCTING RESEARCH IN GDE

Permission may be granted to proceed with the above study subject to the conditions listed below being met and permission may be withdrawn should any of these conditions be flouted:

The District/Head Office Senior Manager/s concerned, the Principal/s and the chairperson/s of the School Governing Body (SGB.) must be presented with a copy of this letter.

The Researcher will make every effort to obtain the goodwill and co-operation of the GDE District officials, principals, SGBs, teachers, parents and learners involved. Participation is voluntary and additional remuneration will not be paid;

Research may only be conducted after school hours so that the normal school programme is not interrupted. The Principal and/or Director must be consulted about an appropriate time when the researcher/s may carry out their research at the sites that they manage.

Research may only commence from the second week of February and must be concluded by the end of the THIRD quarter of the academic year. If incomplete, an amended Research Approval letter may be requested to conduct research in the following year.

Items 6 and 7 will not apply to any research effort being undertaken on behalf of the GDE. Such research will have been commissioned and be paid for by the Gauteng Department of Education.

It is the researcher's responsibility to obtain written consent from the SGB/s; principal/s, educator/s, parents and learners, as applicable, before commencing with research.

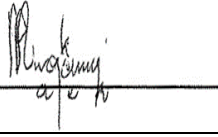
The researcher is responsible for supplying and utilising his/her own research resources, such as stationery, photocopies, transport, faxes and telephones and should not depend on the goodwill of the institution/s, staff and/or the office/s visited for supplying such resources.

The names of the GDE officials, schools, principals, parents, teachers and learners that participate in the study may not appear in the research title, report or summary.

On completion of the study the researcher must supply the Director: Education Research and Knowledge Management, with electronic copies of the Research Report, Thesis, Dissertation as well as a Research Summary (on the GDE Summary template).

The researcher may be expected to provide short presentations on the purpose, findings and recommendations of his/her research to both GDE officials and the schools concerned;

Should the researcher have been involved with research at a school and/or a district/head office level, the Director/s and school/s concerned must also be supplied with a brief summary of the purpose, findings and recommendations of the research study.

DECLARATION BY THE RESEARCHER	
1. I declare that all statements made by myself in this application are true and accurate.	
2. I accept the conditions associated with the granting of approval to conduct research and undertake to abide by them.	
Signature:	
Date:	21 June 2018
DECLARATION BY SUPERVISOR / PROMOTER / LECTURER	
I declare that: (Name of Researcher) MR. P. MUGANI	
1. is enrolled at the institution / employed by the organisation to which the undersigned is attached.	
2. The questionnaires / structured interviews / tests meet the criteria of: Educational Accountability; Proper Research Design; Sensitivity towards Participants; Correct Content and Terminology; Acceptable Grammar; Absence of Non-essential / Superfluous items; <input type="checkbox"/> Ethical clearance	
3. I will ensure that after successful completion of the degree / project an electronic copy of the Research Report / Thesis / Dissertation and the researcher will send a Research Summary (on the GDE template) to the GDE.	
Surname:	
First Name/s:	
Institution / Organisation:	
Faculty / Department (where relevant):	
Telephone:	
Email:	
Signature:	
Date:	

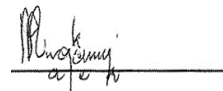
APPENDIX K: ADDITIONAL INFORMATION FOR GROUP RESEARCH

Every researcher / student who will be visiting GDE Institutions for research purposes must complete this information.

By signing this declaration, the researcher / student accepts the conditions associated with the granting of approval to conduct research in GDE Institutions and undertakes to abide by them.

Supervisor/ Promoter / Lecturer's Surname and Name:

DECLARATION BY RESEARCHERS / STUDENTS:

Surname & Initials	Name	Tel	Cell	Email Address	Signature
Mugani	Paradzayi	0835172784	0842783981	paradzayimugani@yahoo.com	

N.B. This form (and all other relevant documentation where available) may be completed and forwarded electronically to Gumani.mukatuni@gauteng.gov.za; Dineo.Mashigo@gauteng.gov.za and please copy (cc) ResearchInfo@gauteng.gov.za.

The last 2 pages of this document must however have the original signatures of both the researcher and his/her supervisor or promoter. It should be scanned and emailed, posted or hand delivered (in a sealed envelope) to Gumani Mukatuni, 7th Floor, 6 Hollard Building, Main and Simmonds Streets, Johannesburg.

All enquiries pertaining to the status of research requests can be directed to Gumani Mukatuni on tel. no. 011 355 0775 or Dineo Mashigo on tel. no. 011 355 0336.

Please attach each Appendix on this application form AND clearly indicate the number and the title of the appendix e.g. (APPENDIX C: QUESTIONNAIRE TO BE COMPLETED BY SGB MEMBERS OF SCHOOLS)

NB: Please submit your application form and appendices as one document

TO: THE PRINCIPAL

School A Secondary School

FROM: Mrs. Hilda Kekana

DISTRICT DIRECTOR: Tshwane South

DATE: 7th September 2018

SUBJECT: PERMISSION TO CONDUCT RESEARCH AT AN EDUCATION INSTITUTION

Dear Sir/ Madam


Permission is hereby granted to P. Mugani to conduct an academic research at your institution.

The researcher shall make arrangements for research with the school management. The school staff, learners and SGB are requested to co-operate with and give support to the researcher. Research findings and recommendations are critical for policy review in public education sector.

The researcher may however not disrupt the normal school programme in the course of research. The research may only take place between the months of February and September. Attached are other conditions to be observed by the researcher.

The school may request for the research outcome presentation directly from the researcher or obtain research document from Research & Knowledge Management Directorate at GDE Head Office.

Regards



Mrs H.E. Kekana

District director: Tshwane South

Date: 10/09/2018

Making education a social priority

Office of the District Director: Tshwane South

(Mamelodi/Eersterust/Pretoria East/Pretoria South/Atteridgeville/Laudium)

President Towers building, 265 Pretorius Street, Pretoria, 0002

Private Bag X198, Pretoria, 0001 Tel: (012) 401 6317, Fax: (012) 401 6318

Website: www.education.gpg.gov.za



Enquiries: Lucky Rapudi

Tel: (012) 401 6317

Fax: 0866 522 388

Email: Lucky.Rapudi@gauteng.gov.za

TO: THE PRINCIPAL

School B Secondary School

FROM: Mrs. Hilda Kekana

DISTRICT DIRECTOR: Tshwane South

DATE: 7th September 2018

SUBJECT : PERMISSION TO CONDUCT RESEARCH AT AN EDUCATION INSTITUTION

Dear Sir/ Madam


Permission is hereby granted to P. Mugani to conduct an academic research at your institution.

The researcher shall make arrangements for research with the school management. The school staff, learners and SGB are requested to co-operate with and give support to the researcher. Research findings and recommendations are critical for policy review in public education sector.

The researcher may however not disrupt the normal school programme in the course of research. The research may only take place between the months of February and September. Attached are other conditions to be observed by the researcher.

The school may request for the research outcome presentation directly from the researcher or obtain research document from Research & Knowledge Management Directorate at GDE Head Office.

Regards



Mrs H.E. Kekana

District director: Tshwane South

Date: 10/09/2018

Making education a social priority

TO: THE PRINCIPAL

School C Secondary School

FROM: Mrs. Hilda Kekana

DISTRICT DIRECTOR: Tshwane South

DATE: 7th September 2018

SUBJECT: PERMISSION TO CONDUCT RESEARCH AT AN EDUCATION INSTITUTION

Dear Sir/ Madam


Permission is hereby granted to P. Mugani to conduct an academic research at your institution.

The researcher shall make arrangements for research with the school management. The school staff, learners and SGB are requested to co-operate with and give support to the researcher. Research findings and recommendations are critical for policy review in public education sector.

The researcher may however not disrupt the normal school programme in the course of research. The research may only take place between the months of February and September. Attached are other conditions to be observed by the researcher.

The school may request for the research outcome presentation directly from the researcher or obtain research document from Research & Knowledge Management Directorate at GDE Head Office.

Regards



Mrs H.E. Kekana

District director: Tshwane South

Date: 10/09/2018

Making education a social priority

TO: THE PRINCIPAL

School D Secondary School

FROM: Mrs. Hilda Kekana

DISTRICT DIRECTOR: Tshwane South

DATE: 7th September 2018

SUBJECT: PERMISSION TO CONDUCT RESEARCH AT AN EDUCATION INSTITUTION

Dear Sir/ Madam


Permission is hereby granted to P. Mugani to conduct an academic research at your institution.

The researcher shall make arrangements for research with the school management. The school staff, learners and SGB are requested to co-operate with and give support to the researcher. Research findings and recommendations are critical for policy review in public education sector.

The researcher may however not disrupt the normal school programme in the course of research. The research may only take place between the months of February and September. Attached are other conditions to be observed by the researcher.

The school may request for the research outcome presentation directly from the researcher or obtain research document from Research & Knowledge Management Directorate at GDE Head Office.

Regards



Mrs H.E. Kekana

District director: Tshwane South

Date: 10/09/2018

Making education a social priority

TO: THE PRINCIPAL

School E Secondary School

FROM: Mrs. Hilda Kekana

DISTRICT DIRECTOR: Tshwane South

DATE: 7th September 2018

SUBJECT: PERMISSION TO CONDUCT RESEARCH AT AN EDUCATION INSTITUTION

Dear Sir/ Madam


Permission is hereby granted to P. Mugani to conduct an academic research at your institution.

The researcher shall make arrangements for research with the school management. The school staff, learners and SGB are requested to co-operate with and give support to the researcher. Research findings and recommendations are critical for policy review in public education sector.

The researcher may however not disrupt the normal school programme in the course of research. The research may only take place between the months of February and September. Attached are other conditions to be observed by the researcher.

The school may request for the research outcome presentation directly from the researcher or obtain research document from Research & Knowledge Management Directorate at GDE Head Office.

Regards



Mrs H.E. Kekana

District director: Tshwane South

Date: 10/09/2018

Making education a social priority

APPENDIX L: SHOWING CODES AND THEMES FOR DATA ANALYSIS

NAMES									
A1	A2	B1	B2	C1	C2	D1	D2	E1	E2
GENDER									
Female	Male	Female	Female	Male	Female	Male	Male	Female	Female
AGE									
30-45	46-55	46-55	30-45	30-45	46-55	56-65	46-55	56-65	30-45
<p>Six of the participants are between the ages from 35 to 65 which means they were born and grew up before the adoption and utilisation of digital technology. According to Nagel (2013), school pioneers and old educators routinely watch mechanical experimentation as outside the degree of their arrangements of desires. Most of these teachers who are BBT are too reluctant to embrace the use of smart boards. They lack self-motivation and skills. Again these teachers are addicted to the chalkboard and cannot let it go. However, smart classrooms have challenged and triggered their interests. The other four participants are those who are born and raised in digital age and regard technology as a key component of their life</p>									
INTERVIEW									
1. For how long have you been teaching?									
Five Years	Seventeen Years	Twenty-five Years	Eighteen	Thirteen Years	Twenty-four Years	Thirty Years	Nineteen Years	Thirty-three Years	Fourteen
<p>The findings revealed that six of the participants have between five- and nineteen-years teaching experience, two participants have between twenty and twenty-five teaching experience. The other two have been teaching for thirty and thirty-three years. Therefore, these participants were suitable for this study due to their interaction and daily experiences with learners in smart classroom.</p>									
2. How often do you use the smart classrooms? Elaborate on its impact on your teaching.									
Theme- Smart classrooms create an environment that is conducive for learning and promotes diversity in Learning									
I use it every time and it has created a good environment for teaching	Regularly, my job is now easier, everything is in my class now	Most of the time, it has changed my teaching way as I am living in a new world full of technological gadgets and now enjoy my teaching.	Frequently, the classrooms are rich with a lot of media to use when teaching.	Always. It has changed my teaching	Regularly, my class of today is now suitable for teaching	Sometimes though I do better when using a marker on a white board	Frequently It has changed learning as it caters for all learners' learning needs and difficulties	Not always as I am still working on my skills	Every day, Smart classrooms have created an environment that is conducive to learning
<p>Most of the participants are using the smart classrooms and this help the researcher to gather correct data, as the study targeted teachers who use smart classrooms daily when teaching. Some of them said that they do better when using a marker on a white board. Participant B1, echoed that she uses the smart classroom every day and she is now living in a new world full of technological gadgets and she now enjoys teaching. Participant E2, expressed that, "Smart classrooms have created an environment that is conducive to learning". While, D2 said, " I use smart class rooms always as It has changed learning as it caters for all learners' learning needs and difficulties.</p>									
3. Did you receive training on the use of smart classrooms? Theme – Training on the use of smart classrooms									

Yes I was trained	Yes but was not sufficient	Yes we were trained	Yes we received training	Not training Workshop	Not at all	Yes but it was Short	Yes I attended a training	Not as such,	Yes, our facilitators trained us
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From the participants, five agreed that they received training on the use of technology in classrooms. Two said they were trained but the training was not sufficient. They are not well equipped with skills to operate the new system. Participant C1 stressed that, no proper training was done to the implementers of the programme. The other three participants were not trained, and lack the skills and proper knowledge on how to go through their lessons using technology. According to Nagel (2014), this leads to underutilisation of the programme or a laying elephant abandoned without anyone to take care of it. Mishra and Koehler (2006) state in the TPACK framework that three component key for effective integration of technology in classroom, these are what to teach, how to teach and that teachers must have the knowledge and skill to use the available technology when teaching their classes using the necessary tool at the right time

4. Do you use smart technology to teach, to plan lessons, to keep records and to communicate? Elaborate

Yes, to teach plan lessons	Not always, to teach	Yes. I use it every day.	Yes to teach, communicate	Yes, the phone we have now smart.	Yes, I use these classes every day when teaching	Yes, am teaching with a smart board	Yes, but not always. Only when it is chatting with my cell phone	Yes, only record keeping I use a laptop	Yes. Technology of today is smart. The phones, tablets and when teaching we use it.
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The use of smart technology has spread widely in all our daily chores. Technology is now part of our life. In the modern world, technology has become the core of all the activities that people do on a daily basis. It is due to this fact that technology has been amalgamated in the education sectors to improve the standard of education as well as the pedagogy, Lukaš (2014). All the participants how they use smart technology in their daily work.

5. For what topics in your subject do you often use the smart board to teach? Elaborate.

I use it in all the topics.	Almost all my lessons I use it.	I enjoy it so I use in in all my lessons.	I use it in all topics and my subject is now interesting every day through the of smart board.	Every topics I use it as it suits my learners needs, they enjoy to fiddle with technology	I use it in most of my topics the only topic am still figuring out is Geometry	Although with ups and downs am trying in all topics	I use it in almost every topic.	Not all. I have a small chalk board to use for other topics	ALL, Smart classrooms have created an environment that is conducive to learning and it caters for all learner
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										s' learning needs and difficulties
--	--	--	--	--	--	--	--	--	--	------------------------------------

Seven participants are using smart boards in almost all their lessons. Two are still trying to figure out how to use technology in their classes. One said, there is small chalk board to use for other topics. Participant **C1** stressed that learners are now enjoying coming for lessons as the environment created in the new classroom suits their needs and the enjoy fiddling with technology. Nowadays learners spend most of their time playing with phones, computer games and watching cartoons on televisions at home. Participant **E2**, expressed that Smart classrooms have created an environment that is conducive to learning and it caters for all learners' learning needs and difficulties. The integration of smart technology in education has brought an environment which make learners to be keen or interested to learn. This can be supported by the statements postulated by Pourciau (2014), when he said, technology is a part of the everyday world, educational leaders need to change the classroom as well as assume the roles in education, a paradigm shift to accept technology as an assistive tool for teachers is necessary.

6. How has the use of the smart classrooms impact pedagogy? Elaborate *Theme- The use of smart classrooms improve teaching and learning*

In life Science it has brought the reality element in my lessons	Smart classes save time in teaching	It has improved teaching and learning methods due to a variety of media on the smart board	Teaching is now easy as the system is conducive to a variety of teaching methods	Learners are enjoying the use of social media to learn. I make them bring their phones for research	No litter on the floor due to reduction in the use of worksheets and papers	Learners have found joy in the touchscreen and it makes them become more interested in learning.	There are a lot of recorded videos that I can choose from to suit their content and subject	Smart technology provoke learners thinking capacity as they learn by themselves. There is diversity and creative teaching	the use of smart classroom has resulted in improved teacher-learner interaction in class. Learners are more active in the modern classroom
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Participant **B2** alluded that, when teaching Life Sciences, she said that there is a wide range of media on internet and these smart classrooms has brought the reality element to class when connected to internet. The three-dimensional media bring life to class. For example, a heart can be viewed in 3d pumping blood into the vessels, in its original colour. She went on to say that, this will make learners fascinated and increase their desire to learn more, thus the use of three-dimensional media is another added advantage of these smart classrooms. Also, the use of visual aid is key to learning. Participant **C1** added that, learners are enjoying the use of social media to learn. She said, she can post a video on WhatsApp group even when she is absent, learners go through it and then answer questions. Sometimes a teacher uses BYOD meaning Bring Your Own Device, where learners bring their own smart phones and use them throughout the whole lesson for internet and class activities

7. Does the use of smart classrooms improve learners' performance?

Yes	It does	100%	Yes, if used effectively	Definitely	Yes	Yes	I am sure it improves	It is improving	Yes, it does
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All the participants agreed that smart classrooms improve learners' performance. Participant **D2** said learners are fascinated by seeing how teachers use these digital devices and how these tools work. Indeed, learners in turn want to explore to discover how the systems work. Mwamwenda (2009) alluded that Piaget stressed that learning takes place during and as a result of active engagement thus educators must provide learners the opportunity to explore and experiment. This participant said that learners grasp concepts permanently when they see real picture, videos and models of what they are being taught of. Learner tend to understand more through the use of colourful media. He also echoed the same views as Participant **D1** when he said attendance has improved in most classes. He thinks that this is the result of the introduction of smart classes that has brought the fun element to class. Learners will be learning as they play with these digital tools as they are too inquisitive to learn more. He added that the most teaching method working is guided and discovery method as he only guides the learners as they learn on their own.

8. What challenges do you meet when using the smart classrooms? Theme--Smart technology is prone to technical faults leading to malfunctioning

My smart board sometimes it freeze	At my school sometimes the boards do not work due to technical problems and proper training	There will be Power failure due to load shedding	Lack of technical support and maintenance	My main challenge is the Malfunctioning of the gadgets	Not knowing where to locate tools to use	Some boards are not working most of the time due to dusty or what they call orientation	The department take time to fix faulty boards	the smart boards do have a lot of problems They can just stop working	Sometimes we have load shedding and we don't have a generator at our school
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Six participants stressed that sometimes the devices are malfunctioning. The other two said there is lack of technical and maintenance support. Two participants alluded that load shedding is affecting them and there is no alternate power supply in their schools. One of the participants said the department takes time to respond to a call and as well as to fix faulty boards. Participant **B1** emphasised that, "the key to effective utilisation and proper implementation of these smart classrooms is pinned on what type of training is there for teachers". The participant said that she did not receive proper training but workshops which she attended the trainer was not well equipped with the skills. Nagel (2014), alluded that key among all difficulties is the absence of sufficient, continuous professional development for teachers who are required to incorporate new advances into their classrooms yet who are ill-equipped or unfit to see new innovations

9. What kind of support do you receive from your colleagues in terms of the use of smart classrooms? Elaborate

When the board freeze sometimes my neighbour help me	I ask my colleagues how to use the board	To attached documents to my presentations	Sometimes the colleagues do not know where to press	They help me to find programmes on the board but they will be in	They show me where to find tools on the board and	We have one teacher who always help us when	They help us if we have problems mostly we	Junior teachers are good when it comes so I depend on	My friends help me to manoeuvre when using the
--	--	---	---	--	---	---	--	---	--

			if there is a problem	classes most of the time	they are helpful	using the smart board	using the boards and e-Books	them on everything and they are helpful and useful	smart boards
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Nine participants agreed that they get help from their colleagues at their respective schools Participant B2 said that the major hurdle they are facing is the technical support for the smart boards, as even her colleagues' lack the skill. She lasts time spent almost a month waiting for the technician from to department to come. She further said the internes based at some of the schools are offering like or no support as they lack this technical knowhow. One of the most boring part of smart boards is they are electrical gadgets and are prone to technical faults Foradian (2013).

10. How do you solve technical problems when using smart classrooms?

I call my colleagues	Intense come and help	The coordinat or solve the problem	The teacher next door help me	We call the helper at the school	My friend help me	ICT coordi nator help everyone at the school	We call the depart ment	Junior teacher s help us	We log a call at the district and they send people to fix
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Four participants said that they call their colleagues if there is a technical problem. The other four stated that they get help from the ICT coordinators and intense at their schools. The remaining two, report to the district or department for help.

11. Do you think the introduction of smart classrooms is critical to education now?

Yes it is.	It is importa nt but more need to done	Absolutel y	Yes, it is importa nt	Very critical	Yes, techno logy is now part of our life	Of course	School s do not have other things, resour ces and facilitie s	It is vital	It is critical but more ground work should be covere d like teacher training
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Seven of the Participants agreed that the introduction of smart classroom is critical to education, and the other two also agreed though they feel more need to be like training of the implementers.

12. What are the positive outcomes of integrating smart classrooms in your school? Theme-- The use of smart technology saves time in teaching and promotes diversity and innovation

Smart classroo ms have made my life and teaching easy as I spend less	Smart technol ogy saves time in teachin g	Smart classroo ms have trained me to be creative	It promot es diversit y in Learnin g	Smart classroo ms improve teaching and learning methods	It helps me to cover a lot of conten t in a short space of time	I now have more time to prepar e my future lesson s	I can integra te with other subjec ts so easily and the world	it has made me to be more innovati ve in the way I teach	I can cover more content in a short time and reach out my learner
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time now							at large		s anytime
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All the participants expressed that smart classrooms have positive outcomes in their schools. Five participants alluded, Smart technology saves their time in teaching, while the other five agreed that it has made them to be more innovative in the way they teach. Participant E2 mentioned that the use of smart classroom has resulted in improved teacher-learner interaction in class. Learners are more active in the modern classroom as they are surrounded by technology everywhere and every day.

13. What are the negative outcomes in terms of teaching, learning and discipline?

malfunctioned devices may result in the loss of teaching time	Students can be addicted to smartphones and laptops thus will not value the presence of the teachers in their class.	Most of the teachers were addicted to the chalkboard and cannot let it go	Teachers lack the skills and proper knowledge on how to conduct the lessons using technology	Disruption and not paying attention as learners at many time are caught watching adult and non-educational materials in class	Technical faults may occur in the middle of a lesson delivery and this may impact on the enthusiasm of learners to learn.	Disruption may occur when they receive calls during teaching and learning.	It makes learners to be exposed to online sites and material that is insane to them which can erode their focus to the subjects	It fosters cheating on tests and assessments	The use of smart phones during class can be dangerous to learners' learning as they misuse the phone.
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Five participants expressed concern over the disruption and loss of focus and concentration among learners as they tend to access certain disrupting website. Two participants are concerned with the malfunction of the devices resulting in loss of teaching time. The other two participants are concerned with teachers' attitude, skills on a smart technology. One participant said that the use of technology foster cheating during tests and assessments as they can send answers to each other.

14. Do you think the integration of these smart classrooms is a sustainable?

yes	Yes it is sustainable	I think it is	It can be sustainable if all parties realise its importance	Of course it is here to stay	Certain measures need to be in place like proper planning	Yes the world is moving to that direction	No it is not as the teachers do not have actual skills for effective usage	definitely	Yes it is but there are some short falls to be addressed on the part of the department like teacher training
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										and security
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Six participants agreed that the integration of the smart classrooms in education is sustainable. Three said it can be sustainable if certain conditions are met. Participant E2 said there are some short falls to be addressed on the part of the department like teacher training and security in schools. One disagreed because the teachers do not have actual skills and knowledge for effective usage of the tools in a smart classroom.

15. What do you think can be done to improve the implementation of smart technology in schools?

The training of teachers should be effective not sprint courses	Safety and security of smart board was one of the major problems	The government should put policy for implementation and evaluation of the programme	The major hindering block is technical faults. There must be trained technicians stationed at each school.	Learners are now vulnerable to thieves as they know that learners carry a tablet. the government and the community must work on security	Some of the internes are do not know what to do when the devices are not working Train them first	Schools should have sufficient resources and budget to run and maintain these smart classes.	There must be an evaluation of the first phase of the project and improve the next rolling off of smart classrooms	There must be proper training and follow up workshops	the government must put tracking devices on these devices in case they are stolen.
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Three teachers are concerned about safety and security of the devices. According to Participant A2, his school has been now a prey of burglaries and at one time, five smart boards were stolen but later recovered. Two emphasise proper training and workshopping of teachers so as to acquire skills and knowledge on usage of smart classrooms. The other two said there must be trained technicians and internes stationed at each school. Two other participants expressed concern policy for implementation and evaluation of the programme. The last participant said the schools should have sufficient resources and budget to run and maintain these smart classes.

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IN THE TSHWANE SOUTH DISTRICT**

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