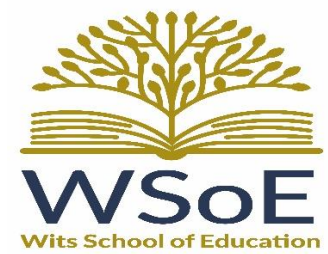


UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG



MASTER'S OF EDUCATION RESEARCH REPORT

An exploration of the integration of ICT in Life Sciences lessons: A case of teachers in Merafong City.

Submitted in partial fulfilment of the requirement for the degree of a Master's Degree in Science Education in the Wits School of Education in the Faculty of Humanities at the University of the Witwatersrand

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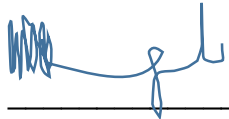
Year: 2023

CERTIFICATION BY SUPERVISOR

I certify that Mr. Sajini Fenni (Student no: 725733) prepared this dissertation at the University of the Witwatersrand, under my supervision, and that it has been examined and approved as meeting the required level of scholarship for the fulfilment of the degree of Master's in Education.

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Date: 24 October 2023

DECLARATION OF ORIGINALITY BY STUDENT

I, Sajini Fenni (Student no: 725733), hereby declare that this dissertation is the result of my own investigations and has not been submitted previously for any degree or diploma in any University. To the best of my knowledge, this dissertation contains no materials previously published by any other person. I further declare that ideas from other sources used in this dissertation have been duly acknowledged.

STUDENT (University of the Witwatersrand)

Signature: 

Date: 15/12/2023

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DEDICATION

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ABSTRACT

The advancement of technology in the 21st Century has transformed educational delivery in various ways, including the use of Information, Communication and Technology (ICT), to enhance the teaching and learning process. In line with this trend, the South African Gauteng Department of Education supplied schools with ICT devices for use in the teaching and learning process, with the aim of improving learner performance in subjects such as Life Sciences. To achieve this aim, teachers are required to integrate educational ICT into their lessons. Despite the provision of ICT devices, the performance of Life Sciences learners has remained poor in Merafong City high schools. The reasons for the continued poor performance of learners, despite the availability of ICT devices has been a matter of speculation. Therefore, this study explored the integration of ICT in Life Sciences lessons, in Merafong City high schools. The study employed a qualitative case study design, and six Life Sciences teachers from both township and city government high schools in Merafong City participated in the study. Data were collected using semi-structured interviews and lesson observations, and were analyzed using a thematic data analysis method. The study findings revealed that the participating teachers have positive perceptions about the integration of ICT into their lessons, and they acknowledged the positive contribution of ICT use in the teaching and learning of Life Sciences. The findings also indicated that not all the participating teachers were competent in the use of educational ICT. In addition, a number of challenges faced by Life Sciences teachers during the integration of ICT in their lessons were highlighted. The implications of the findings are discussed, and recommendations on how to improve the integration of ICT in Life Sciences lessons to mitigate the challenges faced are provided.

Key words: Life Sciences, ICT, integration, challenges, perceptions, competence.

LIST OF ABBREVIATIONS

COVID-19:	Coronavirus disease
DBE:	Department of Basic Education
FET:	Further Education and Training
GDE:	Gauteng Department of Education
HDMI:	High-Definition Multimedia Interface
ICT:	Information and Communication Technologies
NSC:	National Senior Certificate
SAPS:	South African Police Service.
SMT:	School Management Teams
TAM:	Technology Acceptance Model
UNESCO:	United Nations Educational, Scientific and Cultural Organization
USB:	Universal Serial Bus
Wi-Fi:	Wireless Fidelity

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CHAPTER 1: INTRODUCTION AND BACKGROUND

1.1 Introduction

In the 21st century, globally and in South Africa in particular, society has moved to an era of technological advancement, which is made possible by the use of Information and Communication Technology (ICT) (Ahmadi, Keshavarzi & Foroutan, 2011). The ICT advancements have transitioned from the society to the classroom, where various teachers use it in their teaching. ICT use in the classroom refers to the incorporation of computer-based interaction through videos, simulations, visual images and a wide range of technology-based tools into daily classroom instructional processes (Ghavifekr & Rosdy, 2015). A successful ICT integration can be possible with the use of data projectors, smart boards, interactive whiteboards, desktop computers and personal computers in the classroom (UYSEG, 2002). The move has made the South African education system transform from traditional teaching to digital teaching in recent times (Boitshwarelo, 2009; Khalo, 2020). This is because many people, including scholars such as Ahmadi *et al* (2011) believe that ICT incorporation in lessons has a positive impact on the teaching and learning process in schools.

Teachers' perceptions, views and competences about ICT, in the teaching of Life Sciences are crucial. Perception is defined as humans' cognitive ability to use senses to understand the world around them, in order to acquire information about their surrounding environment (McShane & Glinow, 2008). Perceptions can either be positive or negative, based on the teacher's understanding of the use of ICT (Gunzo, 2020). The manner in which Life Sciences teachers perceive the integration of ICT in the teaching of Life Sciences can be influential on the way they teach. Competence is an individual's ability to master something through the use of knowledge, skills and attitude (Daling, 2017). ICT is believed to enhance the teaching and learning and teaching of Science subjects, including Life Sciences. It is therefore essential to explore how ICT is integrated in the teaching of Life Sciences.

However, after several years of advocacy for the integration of ICT in the South African education system post-1994, particularly in the Gauteng Department of Education since

2011 (GDE, 2011), there has been no significant improvement in the performance of learners in some of the school subjects, in the National Senior Certificate (NSC) examination results (Khalo, 2020). Life Sciences is one of the NSC subjects in which ICT is envisaged to be integrated in teaching. In the South African context, the traditional teaching of science subjects, such as Life Sciences, has transformed to ICT based teaching, through the use of technological tools such as smartboards, PowerPoint presentations, USBs, HDMI, WhatsApp communications and Laptops (Ramnarain, Ncube & Teo, 2023). These ICT based tools are used in the teaching of Life Sciences as a technological and presentation tools (Ramnarain *et al*, 2023). The integration of ICT in the teaching of Life Sciences is believed to help learners to construct knowledge and develop skills related to the digital world (Ramnarain *et al*, 2023). Nevertheless, Life Sciences teachers seem to be struggling to produce good results despite the availability of ICT. This inadequacy might be a result of constraints experienced by teachers during the integration of ICT in science classrooms (Pandolfini, 2016). In this regard, the researcher believes that exploring the challenges of integrating ICT in Life Sciences lessons might help in identifying strategies for overcoming the problems faced by teachers in their day-to-day teaching. Therefore, the purpose of the study is to explore the integration of ICT in Life Sciences lessons in Merafong City, where ICT integration in classrooms has been highly advocated.

1.2 Problem statement

The Department of Basic Education (DBE) aims to deliver quality education in the South African education system by 2030, through ICT integrated teaching and learning (Khalo, 2020). The GDE, therefore, made a call to integrate ICT in Gauteng schools in 2011 (GDE, 2011). The goal is to enhance the quality of teaching and learning in both rural and urban South African schools (Khalo, 2020). The use of ICT is particularly necessary for teaching Life Sciences, which requires the use of devices to see invisible biological materials, to do simulations, and to demonstrate processes that cannot be seen by the naked eye. Devices are also required to view organisms that cannot be easily accessed or processes that take too long to be studied within the scheduled school time.

Despite the provision of ICT devices and the call for ICT-integrated classrooms in the schools found in the Gauteng West district, numerous schools in the area, particularly those in Merafong City, fail to obtain high pass rates in the National Senior Certificate examination results, in Life Sciences (DBE, 2020). While many factors could account for the poor performance of learners in Life Sciences, it is possible that the integration of ICT in this subject area is met with challenges. Consequently, teachers might not be integrating ICT effectively in their lessons, which could account for the continued poor performance of learners in Life Sciences. Therefore, it was considered crucial to explore the integration of ICT in the teaching of Life Sciences in Merafong schools, with the aim of enhancing learner performance in the subject.

1.3 Research Aims and Objectives

Aim of the study:

The aim of the study was to explore the integration of ICT in the teaching of Life Sciences in schools in Merafong City.

Objectives of the study:

- To find out Life Sciences teachers' perceptions about the integration of ICT in teaching Life Sciences lessons.
- To determine Life Sciences teachers' views about the contribution of ICT to effective teaching and learning of Life Sciences.
- To establish Life Sciences teachers' competence in the use of educational ICT.
- To identify challenges faced by Life Sciences teachers when integrating ICT in the teaching of Life Sciences, if any.

1.4 Research Questions

Primary Question

To what extent is ICT integrated in the teaching of Life Sciences in Merafong City schools?

Secondary research questions

1. What are selected Life Sciences teachers' perceptions about the integration of ICT in their lessons?
2. What are the teachers' views about the contribution of ICT to effective teaching and learning of Sciences Life Sciences?
3. What are teachers' competencies in the use of educational ICT?
4. What are the challenges faced by Life Sciences teachers when integrating ICT in their lessons, if any?

1.5 Rationale for the study

As indicated earlier, the aim of the study was to explore the integration of ICT in the teaching of Life Sciences in Merafong City schools. Although the study was motivated by personal and academic interest to understand the integration of ICT in Life Sciences lessons, its findings are likely to benefit several stakeholders. For instance, the study findings could help Life Sciences teachers understand the challenges of integrating ICT into their lessons, who would hopefully, address them. The findings might also help the Department of Basic Education (DBE) officials and policymakers to understand teachers' perceptions about the integration of ICT, their view about the contribution of ICT to effective teaching, as well as their competence in the integration of ICT in Life Sciences lessons. This understanding might prompt these stakeholders to come up with mitigating strategies for the identified challenges. Most importantly, the findings from this study could shed light on possible reasons for the continued poor performance of Life Sciences learners in the National Senior Certificate (NSC) examination in schools in Merafong City, even though the Department of Education has availed some ICT devices to schools in the area. The findings from this study could help in finding mitigating strategies to overcome the failure to integrate ICT in the teaching of Life Sciences, which could in turn enhance learners' understanding of Life Sciences concepts.

CHAPTER 2: LITERATURE REVIEW

Introduction

In this section, I reviewed the literature relevant to the study. Firstly, I explained the perceptions of teachers about ICT integration, both locally and internationally. Second, I reviewed literature on the contribution of ICT to teaching and learning, and teachers' views towards it. Third, discussed literature about teachers' competence in the use of ICT devices. Lastly, examined the challenges faced by teachers when integrating ICT in Life Sciences lessons.

2.1 Perceptions on the integration of ICT in Life Sciences lessons.

Several researchers have defined perceptions in numerous ways, but a simple one to understand is that provided by McShane and Glinow (2008, in Mahdum, Hadriana and Safriyanti, 2019). McShane and Glinow described perception as a process that involves understanding our universe and making use of received information to alert us about the surrounding environment. It is evident from McShane and Glinow's (2008) description of perceptions that to regard something as a perception, one must be able to select crucial information and classify it into various categories using prior knowledge. Therefore, perception is a way of using knowledge to plan, categorize, interpret and make sense of the environment around us and adapt to new developments (Mahdum *et al*, 2019).

Mahdum *et al*. (2019) further stated that the teachers must fulfill requirements such as the object, sensory device, and attention to perceive ICT. Therefore, if there is a failure by teachers to meet these requirements, there will be no effective perception of ICT (Mahdum *et al.*, 2019). Mwendwa (2017) identified various aspects that influence teachers' perceptions about ICT. These factors include educational issues such as; being familiar with the use of computers, training intended to develop teachers' skills in ICT, ample time, and hardware and software availability (Mwendwa, 2017 in Mahdum *et al.*, 2019). A study conducted by Ramnarain *et al* (2023) revealed that the integration of ICT by the teachers in the teaching of Life Sciences is done in a manner that supports their traditional perceptions. Resultantly, this forms a complex relation between the teachers' perceptions and integration of ICT in the teaching of Life Sciences (Ramnarain *et al*, 2023).

Literature reveals that teachers have positive perceptions about the integration of ICT in teaching and learning (Krause, Pietzner, Dori & Eilks, 2017; Mahdum *et al.*, 2019). Gunzo (2020) also acknowledged the positive perceptions toward the use of ICT in teaching and learning. Gunzo (2020) revealed that teachers perceive ICT as one of the transformation methods in education, which makes the teaching job much easier because it is time-saving, and makes it possible to easily access information in their subject specializations. Teachers' perceptions towards ICT are enforced by the positive roles it has played in the teaching of various school subjects (Abdullahi, 2014; Khalo, 2020). These roles are discussed in the succeeding section.

2.2 Teachers' views about the contribution of ICT to teaching and learning.

According to Akudulu (2002) in Abdullahi (2014: 217), humans' lives are transformed in various ways by ICT, including; "...manufacturing, communication services, culture, entertainment, education, research, defense, and global security." Al-Rsa'I (2013) stated that ICT tools might enable teachers with skills to facilitate virtual teaching. In addition, ICT affords teachers the ability to implement a digital curriculum, as teaching will involve digital communication (Al-Rsa'I, 2013). It is further stated that ICT stimulates the teachers' understanding and use of digital multi-tools such as simulations, concept map construction, video teaching, and lesson recording (Al-Rsa'I, 2013). ICT also enables teachers to have access to a wide range of materials that can be utilized in teaching (UYSEG, 2002). ICT further affords teachers many opportunities to be creative in teaching (UYSEG, 2002).

Furthermore, Abdullahi (2014) asserted that the use of ICT promotes the teachers' interaction with learners in and out of the classroom. Simon (2014) further stated that ICT increases teachers' opportunities for more communication and collaboration. Becta (2004 in Simon, 2014) added that ICT enables teachers' engagement and motivation of learners to a greater degree in teaching science. Additionally, ICT helps teachers to demonstrate experiments that might be impossible to conduct in a physical classroom (Becta, 2004 in Simon, 2014). Ghavifekr and Rosdy (2015) asserted that the use of ICT in teaching helps teachers to improve classroom management. There seems to be consensus in the literature that ICT contributes to the effectiveness of teaching by enabling teachers to

teach more effectively through the utilization of technology tools (Ghavifekr & Rosdy, 2015). Adelabu and Adu (2014) also stated that the contributions of ICT simplified education through the application of electronic devices and the internet in schools. The question that needs consideration is; what are teachers' views regarding the contribution of ICT to the teaching and learning process?

According to literature (Nowfeek, Farwis & Nowzath, 2021), many teachers perceive the use of ICT in classrooms to be beneficial for effective teaching and learning. This is because they feel that the use of ICT helps both the teachers and learners to engage in lessons and it arouses learners' interest in the lesson (Nowfeek *et al.*, 2021). Most teachers therefore view ICT as a motivational tool that creates engagement, and excitement and enables them to be creative (Nowfeek *et al.*, 2021). In addition, it is evident from the literature that teachers view the use of ICT in teaching and learning as a tool that exposes them to a wide variety of resources essential for teaching (Nowfeek *et al.*, 2021). It would be interesting to find out how South African teachers view the use of ICT in Life Science lessons.

Despite consensus among scholars that ICT use is beneficial to the process of teaching and learning, various researchers believe that the roles of ICT in teaching can only be effective in an educational space, where teachers possess certain attributes. These include positive attitudes towards the integration of ICT, knowledgeable and competence in the use of educational ICT, and in a space that is free from ICT integration challenges (Adelabu & Adu, 2014; Krause *et al.*, 2017).

2.3 Teachers' competence in the use of educational ICT

The role of a teacher in the 21st century is increasingly changing from modelling to coaching learners, supported by the increasing use of ICT in classrooms (Zwaneveld & Bastiaens, 2010). Zwaneveld and Bastiaens indicated that ICT is meant to support teachers in effective teaching, aimed at attaining educational goals (Zwaneveld & Bastiaens, 2010). However, the contributions of ICT to education can only be achieved when teachers are equipped with the necessary skills related to technology and ICT use (Khalo, 2020). Therefore, teacher competence in ICT is regarded as a crucial requirement for ensuring effective integration of ICT (Badau & Sakiyo, 2013).

Competence in ICT integration is underpinned by teachers' knowledge of ICT devices and skills in their use (Badau & Sakiyo, 2013). In this regard, Khalo (2020) stated that teachers' ICT and technology skills enable them to choose relevant ICT tools for teaching Life Sciences effectively. According to UNESCO (2011:13), a competent teacher must possess "technology literacy, knowledge deepening and knowledge creation". Furthermore, a competent teacher should be ICT tools literate (UNESCO, 2011). Hussain (2010) also acknowledges the need for teachers to be technologically competent to be able to use ICT tools and software. In addition, UNESCO (2011) suggested that a competent teacher should possess organizational and administrative skills, as well as willingness to learn about ICT for teaching and learning. However, teachers' competence in ICT integration in Life Sciences differs according different schools (Ramaila & Fakude, 2003). The differences are informed by the teachers' knowledge, their attitudes, and beliefs in ICT integration in Life Sciences (Ramaila & Fakude, 2003).

From the narratives above, it is clear that effective modern education in the 21st century is underpinned by the use of ICT tools (Daling, 2017) and that teachers' competence in the integration of ICT is crucial for effective teaching. This implies that the contemporary way of teaching should integrate more ICT than the traditional way of teaching, which commonly relies on the use of chalkboard and chalk in the classroom. Daling (2017) stated that teachers need to adapt to the modern changing education process, which is underpinned by ICT integration. Daling (2017) further asserted that teachers' competence in knowledge, skills, and attitudes towards ICT integration is of utmost importance in education because it might improve the performance of the school's academic health.

Despite the importance of ICT integration in classrooms and the need for teacher competency in ICT integration in lessons, it is evident in a study by Badau and Sakiyo (2013) that teachers' competency in ICT is low in numerous aspects, although the identified aspects are not specific to the teaching of Life Sciences. Ogechukwu (2016) also found out that most Biology teachers are not competent in the use of ICT. It was therefore deemed necessary to determine the competence of South African Life Sciences teachers in integrating ICT into their lessons.

2.4 The challenges faced by teachers when integrating ICT in Life Sciences lessons.

Various studies reveal numerous challenges faced by teachers during the integration of ICT in education, particularly regarding teaching and learning in the classroom (Ogbomo, 2011; Kola, 2013; Abdullahi, 2014; Belay, Khatete & Mugo, 2020; Khalo, 2020). Some of these challenges are general and not specific to a certain science subject. According to Kola (2013), some of the challenges faced by the teachers in ICT include a lack of funding for the integration, inadequate training for teachers to be familiar with the use of computers, and corruption by the authorities as they take money meant for ICT integration for personal use.

Many scholars (Abdullahi, 2014; Belay *et al.*, 2020; Khalo, 2020) have identified numerous challenges that could hinder the successful integration of ICT in science education. These challenges include:

- Lack of time for teachers to earn confidence and experience in the use of ICT (Abdullahi, 2014).
- Teachers' limited access to the resources required to integrate ICT in their classrooms successfully (Abdullahi (2014).
- Contextual factors that result in the challenges in the successful integration of ICT (Belay *et al.*, 2020; Khalo, 2020).
- Lack of facilities to accommodate technological resources.
- Unstable electricity due to load-shedding interruptions (Belay *et al.*, 2020; Khalo, 2020).

Ramnarain *et al* (2023)'s study identified factors that specifically pose a challenge to Life Sciences teachers' in integrating ICT in their lessons. The study revealed that learners have no smart devices, lack Wi-Fi connectivity, and here is lack of training for teachers to innovatively integrate ICT in Life Sciences (Ramnarain *et al*, 2023). The challenges of integrating ICT in South African classrooms need to be identified so that appropriate mitigating measures can be implemented.

2.5 Theoretical / Conceptual Framework

According to Morgan (2014), theoretical and conceptual frameworks underpin research structure and process. Grant and Osanloo (2014) also referred to the theoretical framework as being characterized by its ability to be a foundation for a research study. This study is guided by the Technology Acceptance Model (TAM; Davis, 1986). According to Davis (1986), TAM is fundamental to various factors, which are perceived as ease of use, perceived usefulness, and attitudes towards the acceptance and use of technology (Ramaila & Fakude, 2003). Therefore, TAM informs this study as the teachers' perceptions are informed by their positivity or negativity towards the use of ICT. The ICT integration of ICT in Life Sciences is also determined by the perceived usefulness of ICT contributions and its perceived ease of use. In addition, the perceived usefulness and ease of use inform the attitudes of teachers to acknowledge the contributions of ICT so as to help mitigate strategies to overcome challenges that inhibit the actual implementation of ICT in Life Sciences. The relationships among these elements are demonstrated in the figure below.

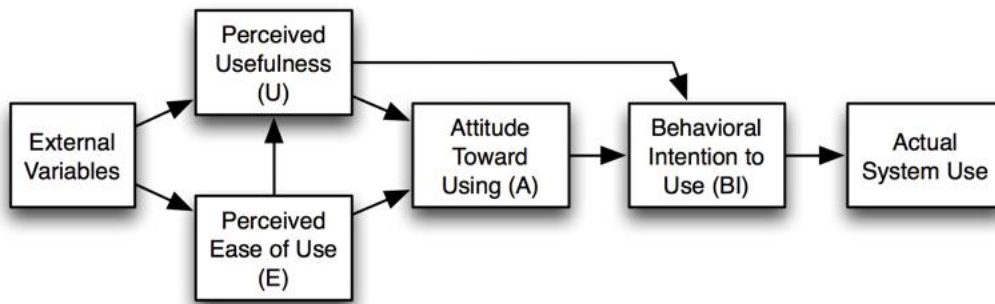


Figure 1: Framework of Technology Acceptance Model

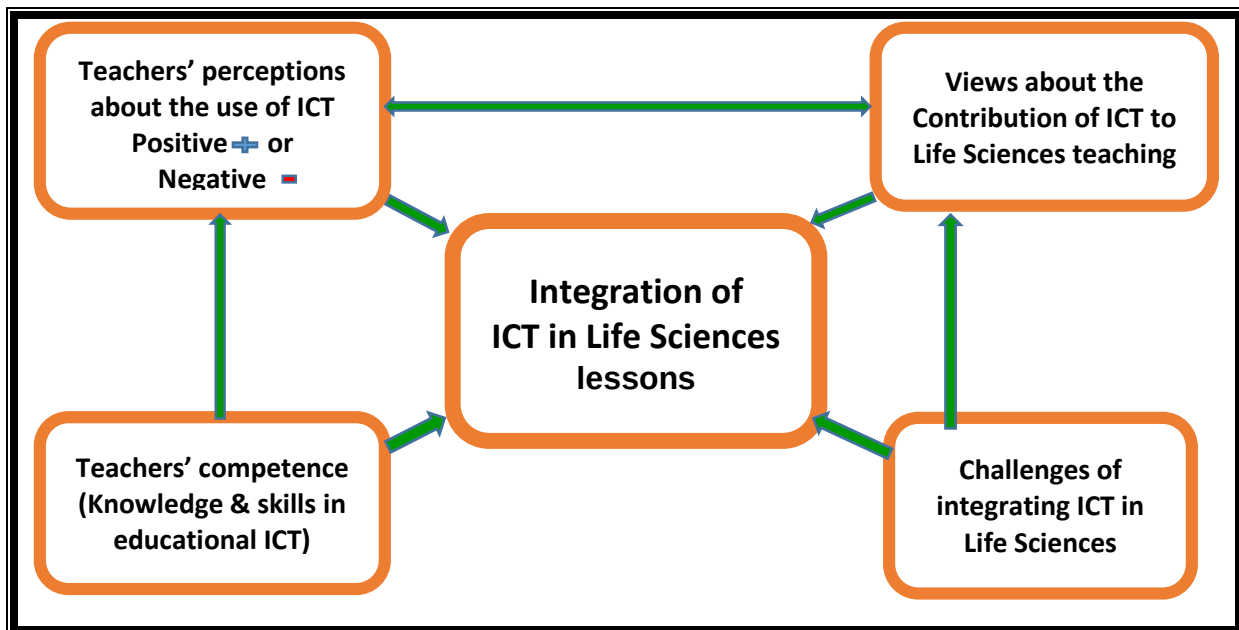
This framework is fundamental to the study to develop insights into the manner in which teachers perceive the use of ICT in the teaching of Life Sciences, their views on the contributions of ICT, the competence and challenges faced in the integration of ICT in Life Sciences.

The study discussed in this report was meant to explore the integration of ICT in the teaching of Life Sciences in Merafong schools and the factors affecting this integration. To achieve this aim, the following objectives were explored.

1. The perceptions that teachers possess about the use of ICT, which can either be positive or negative depending on the teachers' familiarity with the use of ICT (Khalo, 2020).
2. Teachers' views about the contributions of ICT towards effective teaching and learning of Life Sciences could also affect the integration of ICT in Life Sciences lessons.
3. Teachers' competence in the use of educational ICT could affect their ability to integrate ICT into their lessons.
4. Contextual and personal challenges could further affect the integration of ICT (Khalo, 2020).

Therefore, an appropriate conceptual framework for the study of the integration of ICT in Life Sciences lessons should address the stated objectives and their interactions, as shown in the conceptual framework displayed in figure 2.1 below.

Figure 2.1: Conceptual framework for the integration of ICT in Life Sciences lessons.



Source: Author's own computation, 2022.

Based on the displayed framework, the integration of ICT in Life Sciences in Merafong high schools was explored by establishing the indicated factors. These factors might

interact in various ways to impede the integration of ICT in Life Sciences lessons, which could contribute to the poor performance of learners in the subject.

CHAPTER 3: RESEARCH METHODOLOGY

This section outlines the methodology of the study, which includes the; research approach, design, paradigm, population and sample, data collection and analysis methods, as well as ethics considerations.

3.1 Research approach and design

There are three main traditions used in social studies research, namely qualitative, quantitative and mixed methods approaches. In this study, a qualitative approach was used to collect and analyze data about Life Sciences teachers' perceptions towards the use of ICT, their competence in ICT, their views about the contributions of ICT to the teaching of Life Sciences, and the challenges faced by the teachers in their daily teaching of Life Sciences. Creswell (2014) refers to qualitative research as an approach used to explore and understand the meaning-making of problems and issues by humans. He further stated that the qualitative research approach involves the use of open-ended questions, whose answers are analyzed and interpreted using narratives (words) (Creswell, 2014). The qualitative research approach was employed in the study since open-ended questions were utilized to collect data, which were analyzed and interpreted using words rather than numbers (Creswell, 2014). The researcher explored participants' views and knowledge regarding the integration of ICT into Life Sciences lessons, and made-meaning of their responses.

The study employed a qualitative case study research design, which has been defined by various researchers differently. Creswell (2014) refers to a case study as an inquiry plan to assist a researcher to have an in-depth understanding of a case. A case study was suitable for the study because it aimed at collecting detailed information about teachers' perceptions, knowledge, and experiences regarding the teaching of Life Sciences using ICT at the FET phase. The study explored the case of Life Sciences teachers teaching in high schools in Merafong City, in the Gauteng province.

3.2 Research paradigm

Paradigms are considered to be the umbrella of research to signify an understanding of authenticity (Nieuwenhuis, 2007). Kivunja and Kuyini (2017) assert that a research paradigm provides a conceptual lens to help the searcher in examining the research methodological aspects to be utilized. The current study employed an interpretivist paradigm, which according to Kivunja and Kuyini (2017) underpins the efforts made by the researcher to understand and interpret the worldview and experiences of the study subjects. The researcher in this study employed interpretivist to understand and interpret the meanings of teachers' experiences when integrating ICT during Life Sciences lessons. Furthermore, an interpretivist paradigm was adopted to understand and interpret the teacher's perceptions about the integration of ICT in the teaching of Life Sciences and their views about the contributions of ICT in the teaching of life Sciences. In addition, this paradigm helped to make sense of teachers' competence in the use of ICT in Life Sciences and the challenges that they face when implementing ICT in the teaching of Life Sciences.

3.3 Target population and sampling

A population in research is defined as all the individuals who are members of a group underpinned by various forms of elements in a research study, such as human beings, animals, and plants (Gray, Grove & Sutherland, 2017). For a group of individuals or units to meet the criteria for inclusion in a population of research study, it must consist of individuals that will be the focus of the study (Gray *et al.*, 2017). The study was conducted in government schools in Merafong City, in the Carletonville area, which consists of both township and city high schools. The target population of this study, therefore, comprised of FET Life Sciences teachers in Merafong City schools, and the sample of the study was selected from this population.

A sample refers to "part of the population that represents the characteristics of the population" (Kabir, 2016: 169). A study sample is selected using a specific sampling method. Gray *et al* (2017) explained sampling as a way of selecting participants for the study. Furthermore, Ladygay (2015) stated that sampling is regarded as the process whereby the researcher selects individuals from a population to participate in a study.

A purposive convenient sampling method was used to select a sample of six FET in-service Life Sciences teachers from both township and city government high schools in Merafong City, for the study. Purposive sampling is an approach to recruiting participants that can provide the information needed to achieve the aim of the study (Gray *et al.*, 2017). In addition, these Life Sciences teachers were conveniently selected because they were easily accessible by the researcher and they possessed the required information.

The study sample was selected according to the following criteria:

- Participants had to be Life Sciences teachers in a high school in Merafong city.
- Availability of ICT devices in their schools.

From the teachers who met these criteria, the researcher selected those who were willing and whose principals granted them permission to participate in the study.

3.4 Data collection

The researcher employed two qualitative data collection procedures, which are semi-structured interviews and lesson observations. Semi-structured interviews refer to the interaction between the researcher and participants, and it was intended to capture the participants' perceptions about a situation (Creswell, 2014). Semi-structured interviews can be conducted in various forms such as face-to-face or telephonically. Face-to-face semi-structured interviews were used to collect data to answer all the research questions, under the following themes: teachers' perceptions about the use of ICT, contributions of ICT to teaching and learning, integration challenges faced by teachers, and teachers' competence in educational ICT.

The interviews comprised of closed-ended questions where the researcher directed the conversations, as well as open-ended questions where the participants were able to express their views freely (Creswell, 2014). This study adopted face-to-face interviews in order to capture the body language and other non-verbal reactions of the participants. The interviews were audio recorded to protect the identity of participants and to protect those who might not have been comfortable with video recording. During the interview, all COVID-19 protocols were observed.

In addition to semi-structured interviews, the researcher observed two lessons facilitated by each of the selected teachers. Hora and Ferrare (2013) described lesson observation as a way of watching, taking notes, and recording the actions occurring during the act of teaching in a classroom, in actual time. The researcher participated in lesson observations as a complete observer. According to Creswell (2014), a complete observer is a researcher who observes with non-participation. In other words, the observer sits in the classroom to observe what is happening but does not take part in any of the activities taking place in the class. Lesson observations were used to triangulate the data obtained from semi-structured interviews, and to capture some of the information, which the participants might not have revealed to the researcher during the interviews. The same themes included in the interview schedules were also used in the lesson observation schedule. The researcher adhered to COVID-19 restrictions during observations by making sure that all the stakeholders involved were wearing face masks, kept a distance of 1.5 meters, and sanitized during the study.

The above-mentioned data collection methods were suitable for this study because they were likely to enable the researcher to obtain rich data, necessary for answering the research questions (Creswell, 2014).

3.5 Data analysis

During the analysis of data, the researcher is required to transform raw data into sense-making information to answer research questions (Omari, 2011). The study adopted thematic data analysis, which is suitable for the analysis of qualitative data in a case study. According to Creswell (2014), thematic data analysis helps the researcher to understand and analyze data from participants in a case study by interrelating themes for meaning making. Therefore, in this study, the researcher transcribed the data that was collected from semi-structured interviews. This was done by transcribing audio-recorded voices of the participants and lesson observations notes into typed data, which were coded. The coded statements were then categorized into four themes into four themes that were examined by the researcher to make meaning of the data and to answer the research questions of the study.

3.6 Ethics considerations

Research ethics provide guidance to the researchers' conduct when dealing with participants before, during, and post-study, especially human participants (Akaranga & Makau, 2016). Therefore, research ethics are very important in guiding the researcher when conducting a study that would not compromise the rights and safety of the participants (Akaranga & Makau, 2016). In the case of this study, since human subjects were involved, aspects of ethics considerations such as informed consent, anonymity and confidentiality, right to privacy, and protection from harm were addressed.

Informed consent is underpinned by the idea of informing participants about the study and obtaining their consent as crucial elements (Fleming & Zegwaard, 2018). In this study, the participants of the study were informed about the entire research process, including; what they were going to be asked during interviews, how the data collected will be used and the potential consequences of being part of the study (Fleming & Zegwaard, 2018). Participants were also informed that they have the right to withdraw from the study at any point if they feel like doing so. Consent forms were issued to request participants to declare their willingness to take part in the study. The researcher also requested permission from the principals of the participating schools, and the Gauteng Department of Education (GDE) in Gauteng West district (D2), to conduct the study in selected schools.

Anonymity and confidentiality in research ethics relate to not revealing the participants' identities and the information they provide during the process of conducting the study (Arifin, 2018). Therefore, pseudonyms were used to ensure the anonymity of the participants in the study, and that the information provided will not be reported in a way that reveals the identity of the participants. The researcher also assured the participants that the study was free from harm and that the response obtained from them was for academic purposes only. The participants were also informed that all research meetings would only be held at times and places that were convenient to them, to respect their right to privacy. Furthermore, the researcher did not ask participants questions related to their private lives, to avoid invasion of their privacy.

CHAPTER 4: RESULTS

This study was aimed at exploring Life Sciences teachers' perceptions, competencies, and challenges regarding the integration of ICT in the teaching of Life Sciences lessons in Merafong City. The findings of the study are categorized into four themes derived from the research questions, which are: Life Sciences teachers' perceptions about the integration of ICT in lessons, Life Sciences teachers' perceptions about the contributions of ICT to teaching and learning, Life Sciences teachers' knowledge and competence in educational ICT, and the integration challenges faced by Life Sciences teachers.

Statements obtained from interviews and lesson observations were coded as follows. The letters **A**, **B**, **C**, and **D** are used to represent the stated themes. The letter **T** and numbers are used to represent participants, where, **T** stands for teacher, while the numbers represent individual teachers. Hence, the codes **T1**, **T2**, **T3**, **T4**, **T5**, and **T6**, represent the first, second, third, fourth, fifth, and sixth individual participants interviewed. Furthermore, Roman numerals are used to represent individual statements provided by the participants. For example, for the code **T1Ai**, 'i' would be teacher '**T1**'s first response to a question under theme **A**. The findings from the study are presented below, using the described codes. The results will be presented in two sections, namely interview results and lesson observation results.

4.1 Interview results

4.1.1 Life Sciences teachers' perceptions about the integration of ICT in Life Sciences lessons.

The first theme concerns Life Sciences teachers' perceptions about the integration of ICT in lessons. When the participants were asked about what comes to their minds when they think of ICT, all participating teachers' responses revolved around everything that requires technology to transfer information to the learners, in order to make them understand and communicate, as indicated in the quotations below:

T1Ai- "ICT, I just think about everything that involves technology to help these learners understand, I also believe ICT equipment also falls under ICT."

T3Ai- "When I think of ICT, I just think of the technologies that are used in passing the information and also in communication with learners when it comes to teaching in the classroom."

These responses suggest that the teachers perceive ICT to be any teaching resource that involves ICT equipment and technologies, which help to facilitate information transmission to communicate with learners during the process of teaching and learning.

The participants were also asked whether they enjoy teaching using ICT in their Life Sciences lessons. All the participants agreed that they enjoy the use of ICT when teaching Life Sciences as it assists in outlining concepts and processes that need to be visualized for learners to understand, as indicated in the quotations below:

T3Aiii- "Yes, I do. As I have said it assists me a lot because it assists me to relate the ideas in sciences and also make them like visual as I've said that we can use videos, slides, and diagrams so it makes the lesson to be much easier."

T6Aiii. "Yes, a lot. I enjoy it a lot because some of the concepts and the processes are difficult when you just do a talking. So sometimes in ICT, you are able to demonstrate it and make your, make someone's lesson more viable."

This implies that as much as teachers enjoy the use of ICT in teaching Life Sciences, it also helps them to demonstrate content that is not easy to teach using the traditional method of teaching, which is chalkboard and chalk. In other words, the visual images, videos, simulations, and color assist in delivering an attractive and meaningful lesson.

When asked to describe their experience with the use of ICT in the teaching of Life Sciences, most of the teachers acknowledged that they had a good experience, as it made things easier for them in their preparation for effective teaching and learning, even though there is room for more development in their use of ICT. The following quotations indicate some of the responses from the teachers:

T3Aii- "I have a good experience when teaching using ICT in Life Sciences since it's very efficient because it involves the use of different types of resources such as slides, videos, and.... And also it is useful because it shows nice diagrams which can assist both me

and the learners in unpacking the lessons. Also, I think it makes the lesson to be clearer because it prevents confusion. It makes the lesson to be meaningful, yeah.”

T5Aii- “It has been good so far. However, there is more room for development. We are attending teacher training workshops. There is a slot whereby we have training for ICT. So I’m still developing.”

These responses show that most teachers enjoy using ICT in their lessons as it helps them in numerous ways such as time-saving, note preparation, virtual images, and simulations of the content in Life Sciences, to enhance their teaching. They also indicated that the use of ICT in the teaching of Life Sciences makes the teacher's lesson meaningful.

When the teachers were asked what they thought about their learners' interest in learning using ICT, all the participants responded that learners do enjoy learning using ICT because they tend to pay more attention and they do not make unnecessary noise during the lessons, and they understand the content better. Some of the responses by the teachers are shown in the quotations below:

T3Aiv- “Yes my learners, they do enjoy a lot, since they get to see everything which gives them a clear picture about the lesson and it makes them to remember whatever I’ve taught them very easily because they’ve seen it.”

T6Aiv- “Yeah, they enjoy it because those who are always talkative they will pay more attention when I’m using a projector because most of the time I will use the projector because our smart boards they are always having a problem.”

This implies that ICT helps both the teacher and learners. It assists the teacher in classroom management, time management, and effective ways of delivering the content while learners can easily recall what they have learned using ICT.

The teachers were further asked whether they would like more support in the use of technology, by their schools and the department of education. All the teachers' responses were in the affirmative, as indicated in the quotations below:

T4Av- “Yes, I think it would be best if I can get more support and you know, more resources, especially ICT-based, so that we can enhance this teaching and improve it.”

T6Av- “Yes, I wouldn't hesitate on that because most of the teachers, especially the teachers who are old in the field, we have been there for a long time. Some of them, they could not even tap the laptop. So I would encourage the department to offer some sort of mini-courses on Technology so that the teaching becomes easier, and we understand what it is.”

These responses signify teachers' eagerness to more use ICT and their willingness to be innovative in the teaching of Life Sciences in their lessons.

4.1.2 Life Sciences teachers' perceptions about the contributions of ICT to teaching and learning.

The second theme is about the Life Sciences teachers' perceptions about the contributions of ICT to teaching and learning. When the participants were asked if it is necessary to use educational ICT in the teaching of Life Sciences, they all indicated that it is necessary since they afford them alternative ways of teaching, rather than depending on the use of hard copy teaching materials, such as textbooks only. They also believed that it would improve learners' memory. The quotations below show the teacher's responses:

T1Bi- “Yeah... it's more interesting when we use ICT rather than the textbook. You can explore other avenues through ICT.”

T5Bi- “Yes, I really think it's necessary because Life Sciences has topics that need to be taught or explained in an audio-visual way. So it helps a lot using ICT tools in the class so that learners' memory is improved.”

This shows that the teachers acknowledge that educational ICT helps them to explore various teaching methods to cover lessons and to enhance the learning of Life Sciences.

The participants were asked how they think ICT use helps in the teaching and learning of Life Sciences. The teachers responded that ICT caters for different learning styles and

helps with time management, while a lot of content is covered. These ideas are reflected in the following statements provided by the participants:

T3Bii- “The use of ICT, ok, since Life Sciences is a broad subject I think it is important because it summarizes the lesson in a short period of time and also it gives a clear picture about the lesson, which prevents confusion; since Life Sciences is about macro and also micro-organisms. It's about all living organisms. So some of the things are difficult to make learners understand because they haven't seen them, such as micro-organisms. So it becomes easy when you are using ICT because learners get to see those types of animals and it also assists since Life Sciences also focuses on the History of Life. So I believe that when I use ICT most of the time, I find it easy for learners to understand the History of Life. And as I've said earlier on, it allows learners to understand easily.”

T5Bii- “I think it's to cater for different learning styles because some learners are visual, while some are auditory. So they remember by seeing and by listening. So using PowerPoint presentations and videos to demonstrate your lessons, I think it's beneficial for them.”

This implies that teachers are aware that the use of ICT helps them to cover a lot of content within a short period and minimizes confusion since it caters for auditory and visual learning styles.

Furthermore, the teachers acknowledged that ICT evokes learners' interest in the subject, because it makes the learning of Life Sciences fun, and it assists in exploring more diverse activities, as indicated in the quotations below:

T1Biii- “Yeah, more diverse activities, and the cooler part again is that with these online activities, you can ensure that everyone is actually playing a role, compared to these activities from handouts and the textbook, whereby they may copy. So if everybody has his or her own device, I can monitor whether the learner is doing his or her job individually so.”

T5Biii- “It makes the learning of Life Sciences fun. Teachers and learners find creative ways to learn concepts in the subject using ICT. For example, we may use word search,

and crossword puzzles to learn biological terms. So it will be easier for them to remember what they have learned when using ICT.”

These responses show that teachers appreciate the use of ICT in their lessons as it helps them with creative strategies to make Life Sciences an interesting and engaging subject.

Concerning the question about the areas of Life Sciences lessons that they think mostly require the use of ICT, their responses included; the demonstration of experiments, the teaching of processes, and topics such as fertilization and menstruation in human reproduction, as indicated in the statements below.

T4Biv- “I would say almost all of them, but you know you look at topics that have processes. For example, you look at the process of, maybe, fertilization in Grade 12. Or when you look at the process of menstruation, you know the whole process as it occurs. Learners can then learn better if they see it. So those are some of the few things, the few parts of Life Sciences I think require the use of ICT more than the others.”

T6Biv- “Practical, I mean the experiments right, some investigation, processes like as I’ve said DNA code of Life in Grade 12.”

This implies that teachers feel that almost all the content in Life Sciences but demonstration of practical experiments and processes such as menstruation, and fertilization are some of the examples that require the use of ICT.

The question on how the use of ICT could impact the teachers’ teaching of Life Sciences was posed. All the teachers agreed that ICT impacts the teaching of Life Sciences positively, as expressed in the quotations below:

T1Bv- “I feel that it can impact it in a positive way in that the results are going to be positive; since I feel that if we use ICT then the learners will better understand the content.”

T3Bv- “It impacts the teaching positively as it creates a clear picture about the lesson. And it allows the learners to relate Life Sciences with their daily experiences. And also it creates love for the subject and it also makes it easy for learners to understand. And also make it easy for the teacher to deliver a meaningful lesson.”

These responses suggest that the teachers are aware of the impact of ICT use in the teaching of Life Sciences as it affords learners better opportunities to understand the content, helps to make a lesson clear, and assists in relating the subject with the learners' real-life experiences.

In addition, the participant's response to the question about differences that they have noticed (if any) in their learners' interest in the study of Life Sciences, before and after the use of educational ICT was that they have noticed differences in terms of behavior in the classroom. These differences include; learners bringing their study material to the class, in the form of textbooks, easy recalling of the information taught, increased interest in the lesson, and paying more attention during lessons. These views are expressed in the quotations below:

T3Bvi- "The learners, pay more attention after introducing ICT in my institution."

T5Bvi- "Before, they were not able to remember the information taught. When, the following day maybe, I can ask them what we did in class, what did you understand, they would find it difficult to explain. But then after using ICT, for example, video to illustrate the processes, they are able to recall the information faster. So it helps a lot with their memory."

The participating teachers seem to suggest that ICT motivates learners to pay attention during the lesson and to recall the information taught.

4.1.3 Life Sciences teachers' knowledge and competence in educational ICT.

The third theme refers to Life Sciences teachers' knowledge and competence in educational ICT. When the participants were asked whether they use ICT in their Life Sciences lessons, they all replied in the affirmative, but they stated that they do not use it on a daily basis due to contextual factors such as limited devices and lack of electricity, as shown in the quotations below:

T3Ci- "Yes, I do but not every day. Sometimes there is no electricity"

T6Ci- "Let me be honest, I only use it sometimes because the devices are not enough for the whole school."

These responses indicate that the teachers try to integrate ICT in their lessons but they do not do so to their satisfaction because of contextual factors that hinder its use. In this regard, load shedding and insufficient ICT tools are some of the factors that prevent teachers to incorporate ICT in the teaching of Life Sciences. When the question about the teachers' confidence in the use of educational ICT in teaching Life Sciences was raised, four of the six participants' responses showed that they were confident and two indicated that on a scale of one to ten, they would say 8 out of 10. These responses are demonstrated in the quotations below:

T4Ciii- "I'm well confident, you know. I'm well confident me saying if I had to put it in numbers, I would say 80% confident."

T5Ciii- "On a scale of 1 to 10, I can say 8, but there could be more ways of using ICT in class that I can learn, which I have not tried."

The teachers' responses signify their confidence and the ease with which they use educational ICT when teaching Life Sciences.

The teachers had to answer a question on how familiar they are with the use of ICT in the teaching of Life Sciences. Their responses showed that they are quite familiar with it, but they are still learning new skills. The quotations below show some of the teachers' responses:

T4Cv- "I'm well familiar. I can use ICT to do a lot of things, to construct questions, and diagrams, to do videos, and all of those things. So I'm familiar, well familiar."

T5Cv- "I'm more familiar. However, there is still more room for learning new skills on how to use the ICT in the classroom."

This shows that teachers are aware of some of the educational ICT tools that are available in their schools and they are willing to learn new skills required for ICT use in their lessons.

When the teachers were asked how well accustomed they are to the use of educational ICT, four of the six teachers confidently answered that they are proficient in the use of ICT, since they can use computers and smart boards and they can create WhatsApp groups for communication with learners. However, two teachers said that they are

beginners because they are not familiar with ICT gadgets. The teacher's responses are evident in the quotations below:

T2Cii- “I cannot say I am a beginner user of ICT because even at school I did computer studies. So, I may say I am proficient because I know almost everything about ICT. I’m able to integrate ICT into my lessons. I’m able to use those smart boards. I’m able to create whatever that I need to create, like WhatsApp groups where we can communicate and all those things. So yeah I’m proficient.”

T3Cii- “I would say I’m a beginner user of ICT, as I’ve said that I’m not familiar with some ICT gadgets. I’m only familiar with the smart board and whiteboard overhead projector. So I would say I’m a beginner.”

It appears that teachers make use of ICT such as smart boards, laptops, cellphones to communicate via WhatsApp, USBs, overhead projectors, and connecting laptops to the smart boards using High-Definition Multimedia Interface (HDMI), which are available in their classrooms. This means that the teachers are aware of the ICT tools used in the teaching of Life Sciences. However, it seems that they are not all well accustomed with the use of ICT tools such as discussion boards, meeting platforms, collaborations, quizzes and assignments, item banks, etc., which make teaching and learning more effective, as none of the participants mentioned them.

The question on how often the participants make use of the available educational ICT in the teaching of Life Sciences was asked, and they responded that they do not use them all the time, but they do so when they are available for use, and depending on the topic, as indicated in the quotations below:

T1Civ- “This one depends on the topic that I am teaching, but I try to use it as often as I can, especially when conducting experiments.”

T4Civ- “I would say 50% of the time, yeah. Half of the time I do resort to using ICT.”

The participants’ responses suggest that the teachers’ use of ICT depended on its availability and on the topic to be taught.

One of the questions that was asked to the participants was based on the type of ICT devices and resources that they use in their Life Sciences lessons. The participating teachers mentioned laptops, cell phones, overhead projectors, whiteboards, smart boards, and USBs, as indicated in the quotations below:

T1Cvi- "It's the laptop, the smart board, ummh the phone, the learners can also use their phones while I also use my phone for those who do not have laptops or if the smart board isn't working. Yeah, those are the ones that I use. I haven't yet gotten to these online activities and all that."

T3Cvi- "Smartboard, whiteboard, and also an overhead projector."

These responses indicate that teachers know and understand some of the ICT devices and resources that are helpful in the teaching and learning of Life Sciences. Teachers' responses also show that they are trying be competent in the use of ICT in the teaching of Life Sciences.

The participants were also asked if they have received any form of training in the use of educational ICT and how often. The teachers indicated that the training was provided, but not more often just for a short period. The quotations below indicate the teachers' responses:

T2Cvii- "Yes I did receive the training, not very often, but I did receive training on ICT. Hence it becomes user-friendly to me because I've been trained, also while I even did my computer studies back at school."

T6Cvii- "I received the training. I think when the smart boards were provided. I think it was 2012 somewhere there. So not often, they did it I think twice. They did the first round and the second round then they stopped, yeah."

These responses imply that the teachers did receive training in the use of educational ICT after the installation of smart boards, but not often.

Furthermore, the participating teachers were asked about the type of educational ICT training that they received. The teachers alluded to training on smart board use and Microsoft Word and Microsoft Excel, as shown in the quotations below:

T1Cviii- “The training these guys taught us was the use of Word documents, they taught us to use, what’s this other one? Excel! But those ones we knew them from ‘varsity’. So the most interesting part that they taught me was doing these live activities with the learners. Whereby you set up an activity online and then the learners can do the activities and then you can monitor each and every learner, but the problem with integration of ICT is that the Wi-Fi is not always available so we cannot all be connected at the same time.”

T3Cviii- “The use of smart boards, whereby they put this thing, I don’t know what is that. There is a gadget that they put at the back of the smart board whereby you can insert the USB, insert this thing the one for a mouse, when you are using the cordless mouse and also we got training on using the loaded resources in the smart board. We also got training on how to make period registers using ICT, and how to use ICT in interpreting data. Let us say you are making an investigation, so now you have data that you have accumulated. So they also trained us on how to use ICT in just interpreting the data, in the form of graphs and spreadsheet or Excel.”

It is evident from the teachers' responses that they were trained on how to use ICT tools such as smart boards, Microsoft Word, and Microsoft Excel and the connection of small gadgets like USBs to the smart boards.

4.1.4 ICT Integration challenges faced by Life Sciences teachers.

The fourth theme is about the integration challenges that Life Sciences teachers face when integrating ICT into their lessons. The question asked to the participants was based on the support that they receive from the school in the use of ICT in lessons. The teachers responded that their schools provide no support for the use of ICT, tools that are available. This is evident in the quotations below:

T3Di- “I would say the school does not support because we don’t have proper infrastructure and we only have one class with Wi-Fi, and another problem is that we are having a network problem in our community. And in the school, we only have two classes with smart boards. So we are not supported.”

T6Di- “No support, let me be honest, the ICT committee is there, but there is no support because the smart boards are not even protected. The committee is there or that body for ICT is there but they are not fully functional.”

This suggests that the teachers do not receive enough support from the school to integrate ICT into their lessons.

When the teachers answered a question about the internal challenges that they often experience in the teaching of Life Sciences using ICT, they referred to the lack of resources, problems with electricity, lack of relevant infrastructure, lack of Wi-Fi connectivity, and lack of maintenance for the smart boards among the problems mentioned. These responses are shown in the quotations below:

T1Diii- “Ehhh, internal challenges my guy, like I said electricity and some resources are not really available in classes. You have to go get it maybe that side, use it after you gotta take it back. So it takes time.”

T3Diii- “It’s fewer ICT classes because as I’ve said, we don’t have proper infrastructure so the classes with ICT smart boards are also used for other classes. So when you have to access them, you have to make an arrangement. You can’t just have access at any time, and also we are having a problem with connectivity, network connection.”

It appears that the teachers often experience internal challenges in the integration of ICT in the teaching of Life Sciences, such as a lack of Wi-Fi, properly functional ICT tools, and infrastructure.

When the teachers were questioned about external challenges they often experience in the teaching of Life Sciences using ICT, they alluded to cable theft around the school, poor network and Wi-Fi connectivity, load shedding, and vandalism, as indicated in the quotations below:

T2Div- “The external [challenges] I should think are those that I alluded on to say there is cable theft that is taking place, also when I will find out that at school now we don’t have electricity and stuff but they are very minimal. Those external are minimal because we

are in the mining area, they also support us in terms of making sure that everything is running smoothly.”

T6Div- “Load shedding, and as I’ve said, vandalism, those are the challenges that are letting us down.”

The teachers' response suggests that there is a lot to be done to overcome these external challenges for a possible fully functional ICT classroom.

The participating teachers were further asked if it is easy for them to access educational ICT for use in their Life Sciences lessons. The teachers responded that they find it not easy whenever it is required for use because challenges like the smart board not being maintained pose a challenge, as evident from the teachers' responses in the quotations below:

T1Dv- “Yeah, like I said, the smart boards are always there. It’s just a matter of them working because sometimes they do have problems but other resources we need to go get them but I feel that the smart board man, it kills everything, you don’t need a projector when you have the smart board, you know. It has everything. The only thing is that we don’t have labs so we have a center that serves as a lab but it’s small. I can’t take learners there, so what I have to do is collect the resources and then go with them to class, yeah.”

T3Dv - “It’s not easy.”

This implies that it is not easy for teachers to access educational ICT, since challenges such as lack of maintenance for smart boards, and lack of ICT laboratory hinder their access and hence the integration of the ICT process.

In addition, a question on the educational ICT devices and resources that are available in their schools was asked. The participants mentioned laptops, cell phones, smart boards, learner tablets, Wi-Fi, and projectors were available. These responses are indicated in the quotations below:

T1Dvi- “Yeah, in the entire school? We have lab equipment, smart boards, and some Wi-Fi but usually, the Wi-Fi is not always accessible for smart boards. We can access the Wi-Fi for our laptops, but the smart boards do not have Wi-Fi. And also we have the

overhead projectors. I once saw this thing for transparencies, yeah but the thing is it also needs an OHP, yeah so I don't think that anybody uses that one."

T5Dvi- "Smartboards, laptops, learner tablets."

The teachers' responses imply that the schools have educational ICT for use by the Life Sciences teachers, but some devices are not connected to Wi-Fi.

4.2 Lesson observations

The researcher observed some lessons to determine how participating teachers used ICT in their lessons. Data were collected using observation schedules, by observing 45-minute Life Sciences lessons presented by each of the participating six teachers. The observation schedule used to collect data contained items that relate to Life sciences teachers' knowledge and competence in the use of educational ICT, and ICT integration challenges faced by Life Sciences teachers. The items on the observation schedule involved a Likert scale, where the researcher indicated whether the item was executed very often, often, sometimes, seldom, or never. The findings from the analysis of the data are reported below.

4.2.1 Evaluation of Teacher 1's lesson

Teacher 1's lesson was about plant response to the environment, which is a Grade 12 topic. The teacher used a smart board to display the slides used during the lesson. The focus of the lesson was on the role of auxins in phototropism and geotropism. The teacher facilitated the lesson by displaying images showing how plants respond to light stimuli and gravity. The teacher further explained the plants' defense mechanisms against herbivores. The teacher showed an understanding of how ICT works by connecting his laptop to the smart board using HDMI. During the lesson, the learners were very attentive and actively responded to the questions posed by the teacher. The following quotation shows the teacher's introductory statement of the lesson, *"Good morning, learners. As you can see on the smart board, our focus is on the role of auxins in aspects of tropism. I sent the slides you see on the smart board to our WhatsApp group last night."* This shows that the teacher used ICT, a smartboard, to promote learning.

The lesson reflected the Life Sciences teacher's knowledge and competence in the use of educational ICT. For example, the teacher could connect ICT devices such as the laptop to a smart board using HDMI. The teacher, further, used his ICT knowledge to display slides and pictures about the lesson on the smart board. However, the teacher was faced with the integration challenge of a smart board that took time to start working, after it was switched on. This is the result of a smart board that is not maintained regularly. As a result, this challenge wasted about five minutes of the lesson, while the teacher was waiting for the optimum functioning of the smart board.

4.2.2 Evaluation of Teacher 2's lesson

The lesson was about cell division, focusing on the process of mitosis, which is a Grade 10 topic. The teacher uploaded slides and a video on the smart board, using a USB. The slides contained notes on Mitosis. Before the teacher could start the lesson, the learners were instructed to form four groups of five learners. The teacher requested the learners to watch a video, which showed how cell division occurs during mitosis. While watching the video, the teacher facilitated the lesson by playing and stopping the video to explain the process of each phase of mitosis. After watching the video, each group of learners was supplied with a glue stick, scissors, blank papers, and various colored pencils, to construct each phase of mitosis: prophase, metaphase, anaphase, and telophase. Each of the four groups had one phase to construct. The lesson reflected the teacher's effective use of multimedia such as images, slides, and videos to explain scientific concepts and processes. The teacher also used traditional technological devices such as; glue sticks, scissors, blank papers, and colored pencils.

The teacher's lesson demonstrated his knowledge and competence in the use of educational ICT. For example, the teacher used a USB to upload slides with notes and videos on a smart board and further played the video and kept on pausing it to explain certain concepts and ideas to the learners. The teacher also used glue sticks, scissors, blank papers, and colored pencils to integrate educational ICT with traditional technologies. The integration challenge faced by the teacher was to construct the phases of mitosis by the learners using the scissors and papers in the classroom, as it was time-consuming for them to follow the instructions step-by-step. As a result, the lesson ended

with 3 of the 4 groups not completing their work. Below is the teacher's instruction to the groups that could not finish the construction of phases of mitosis; *"the period is now over and the groups that have not finished just put the material safe in the cupboards, then during our period tomorrow we will continue."* Limited time was therefore one of the challenges that could have affected the integration of ICT in Life sciences lessons.

4.2.3 Evaluation of Teacher 3's lesson

The teacher taught Grade 11 learners about gaseous exchange in humans. The learners were seated in pairs, in a normal classroom setting. The teacher used HDMI to connect his laptop to the smart board and used her cellphone to hotspot the laptop for internet connectivity. She then browsed through Google searching for YouTube videos. The learners were allowed to watch the YouTube video about the dissection of the lungs. During the video watching, the teacher kept on pausing to identify and indicate the important parts and requirements for efficient gaseous exchange. However, the video had glitches at some point due to poor network, which led to poor internet connectivity. The learners paid attention during the lesson, and they identified some of the parts that they saw in the video and their textbooks. After the video, the teacher gave classwork to the learners to label the structure involved in gaseous exchange in humans. The quotations below show the teacher's words during the lesson, *"... for the gaseous exchange system to work efficiently, the gaseous absorption surface must be large, thin and permeable, moist, protected, ventilated and vascular, as you can see in the video"*. The teacher used a video (ICT) to demonstrate the location, appearance, and characteristics of the gaseous system. Hence, he used ICT to enhance learners' understanding of gaseous exchange in humans.

The teacher's ability to use HDMI by connecting the laptop to a smart board and to hotspot the laptop for internet connectivity, using a cellphone emulated the teacher's knowledge and competence in the educational use of ICT. For example, the teacher's knowledge of using HDMI, a laptop, and a smart board and of connecting them to the internet, using a smartphone demonstrated his competence in the use of educational ICT. The teacher was faced with the challenge of internet connectivity, due to poor network. For example, poor network resulted in glitches on the YouTube video used by the teacher to teach.

4.2.4 Evaluation of Teacher 4's lesson

The observed lesson was on a Grade 12 topic titled Human Evolution, and it focused on the evidence of common ancestors for living hominids, including humans. Teacher 4 uploaded a PowerPoint presentation on a smart board, using her USB. The PowerPoint slides comprised of pictures and notes explaining fossil evidence for the *Ardipithecus*, *Australopithecus* and *Homo* groups. The learners seemed to be very interested in the lesson, as they kept on laughing and seemed excited when the teacher displayed a picture on the screen. The teacher focused on explaining the content of the PowerPoint presentation. For example, he explained that; *“as you can see in the pictures displayed on the smart board, there are fossils of Ardipithecus, Australopithecus, and Homo that have been found in Africa to support the theory of Human evolution.”* These explanations raised many questions from the learners.

This lesson reflected the teacher's knowledge and competence in the use of educational ICT. For example, the teacher could use ICT devices such as uploading a PowerPoint presentation on a smart board, using a USB. The teacher could also display pictures on PowerPoint slides. Unfortunately, the teacher faced an electricity challenge, because the lesson was interrupted by load shedding. Therefore, he could not complete the lesson.

4.2.5 Evaluation of Teacher 5's lesson

During the lesson observation, teacher 5 focused on Homeostasis in humans, specifically thermoregulation, which is offered in term 3 in Grade 12. The teacher had prepared the lesson to be delivered using PowerPoint presentation, on a smart board. He connected his laptop to the smart board using HDMI and started the lesson by displaying a diagram showing what happens to the skin of a human on a cold day. However, he could not finish explaining vasoconstriction using the smart board; because of load shedding that disrupted the lesson and the concentration of the lesson. The teacher ended up opting for traditional teaching, where he used a chalkboard to finish his lesson. This demonstrated electricity challenges during the integration of ICT in the teaching of Life Sciences. This constraint is reflected in this statement from the teacher; *“... listen learners, despite the load shedding, we are not going to stop the lesson, but let us*

continue, and tomorrow when there is electricity, remind me to display the diagrams showing the observable differences between vasoconstriction and vasodilation.”

The lesson demonstrated the teacher’s knowledge and competence in ICT educational use. For example, the teacher used HDMI to connect the laptop to a smart board and displayed a diagram on the PowerPoint presentation. However, load shedding became an ICT integration challenge because the teacher could not finish the lesson with ICT, which led to the traditional teaching method of chalk and board.

4.2.6 Evaluation of Teacher 6’s lesson

The lesson was about evolution through natural selection. The teacher specifically focused on speciation through geographic isolation. ICT devices such as a laptop, and a smart board were available in the school. However, the teacher did not bother to use the available ICT, as the smart board was not functional. The teacher delivered the lesson using the traditional method of drawing and writing notes on the chalkboard to try to clarify scientific concepts because the available smart board was not functional. The teacher explained to the learners that; *“Unfortunately learners, the smart board is not working and the projector is unavailable for use because you were going to see clear pictures that show the process of speciation. I also have a nice video that I wanted to play for you but at this point it is impossible”*

The lesson did not reflect the teacher’s knowledge and competence in the use of educational ICT. For example, ICT devices such as a laptop and a smart board were available, but the teacher did not use them. Instead, the teacher opted for the chalk and board traditional way of teaching and used the dysfunctional smart board as the reason for not using ICT in the classroom.

The challenges demonstrated in this lesson are the non-functioning ICT devices, such as the smart board. The teacher’s failure to use available ICT devices was another challenge, which could have been a result of a lack of ICT knowledge. There was also the challenge of a lack of electricity due to load shedding.

Overall, from the lesson observations, it was evident that the participating teachers attempted to use ICT to a limited extend. However, they did not use a diversity of ICT

devices and techniques, such as computer-based interaction through videos, simulations, visual images and a wide range of technology-based tools into their classroom instructional processes, as expected in effective ICT integration into lessons (Ghavifekr & Rosdy, 2015). Teachers' self-reported competence in the use of ICT could therefore not be established conclusively from the lesson observations.

4.3 Summary of Findings

The following is the summary of findings from this study:

- The selected Life Sciences teachers had positive sentiments about the integration ICT into Life Sciences lessons and they showed some understanding of how ICT could be integrated into their lessons.
- Life Sciences teachers acknowledged the positive contributions of ICT in teaching and learning, such as the learners' improved memory and active participation in lessons, covering of content in a short specific period, ability to use a wide range of activities, and making the learning of the subject fun.
- Four of the six participants claimed to be proficient in the use of educational ICT because they were exposed to a variety of ICT devices and resources during ICT training.
- The challenges experienced by the Life Sciences teachers during ICT integration include; insufficient school support, poor network and internet connectivity, electricity problems due to load shedding, cable theft and vandalism, and lack of maintenance of educational ICT devices, such as smart boards, in classrooms.

4.4 Conclusion

In this chapter, I discussed the findings pertaining to selected Life Sciences teachers' integration of ICT in Life Sciences lessons, their perceptions about the contribution of ICT to teaching and learning, their competence in the use of educational ICT, and the challenges they faced when integrating ICT in Life Sciences lessons. In the next chapter, the findings of this study will be discussed. The implications of the study will also be explained and recommendations will be made.

CHAPTER 5: DISCUSSION OF RESULTS AND CONCLUSIONS

This chapter will focus on the discussion of the findings of the study. The chapter includes a summary of the study, a discussion of the findings, the limitations of the study, a conclusion, implications of the findings, and recommendations.

5.1 Summary of the study

The purpose of this study was to explore the integration of ICT in the teaching of Life Sciences in schools in Merafong City. In order to achieve this purpose, the following objectives of the study were explored: (1) To find out Life Sciences teachers' perceptions about the integration of ICT when teaching Life Sciences in high schools. (2) To determine Life Sciences teachers' views about the contribution of ICT to effective teaching and learning of Life Sciences. (3) To establish Life Sciences teachers' competence in the use of educational ICT. (4) To identify challenges faced by Life Sciences teachers when integrating ICT in the teaching of Life Sciences. The study was guided by a conceptual framework for the exploration of factors that could affect the integration of ICT in the teaching of Life Sciences in Merafong City schools, which was formulated by the researcher. This conceptual framework consisted of four parts, namely; Life Sciences teachers' perceptions about the use of ICT, their views about the contribution of ICT to Life Sciences teaching, their competence (knowledge and skills in educational ICT), and the challenges they experienced during the integration of ICT in their lessons. Data was collected using semi-structured interviews and lesson observations and were analyzed using thematic data analysis.

The study used a case study research approach, which allowed the researcher to explore the integration of ICT in the teaching of Life Sciences in Merafong City schools. A case study enabled the researcher to collect detailed information about teachers' perceptions, knowledge and experiences, and challenges faced regarding the teaching of Life Sciences using ICT at the FET phase. In addition, the use of semi-structured interviews was pertinent to the study because they helped the researcher to obtain the answers to the research questions, under the following interview schedule themes: teachers' perceptions, contributions of ICT to teaching and learning, integration challenges faced

by teachers, and teachers' competence in educational ICT. Furthermore, during lesson observations, the same themes included in the interview schedules were used in the lesson observation schedule. Lesson observations were employed to triangulate the data obtained from semi-structured interviews and to capture some of the information, which the participants might not have revealed to the researcher during the interviews. However, teachers' fear of being interviewed and observed during their lessons presented a problem of collecting data, since various participants kept on withdrawing from the study, which resulted in the study taking longer than expected.

5.2 Discussion of the findings

As stated earlier, this study sought to explore the integration of ICT in Life Sciences lessons by Life Sciences teachers in Merafong City high schools. The findings related to the research questions are discussed below.

5.2.1. Teachers' perceptions on the integration of ICT in Life Sciences lessons.

The first research question explored Life Sciences teachers' perceptions about the integration of ICT in their lessons. The finding related to this question is that the teachers have positive perceptions about the integration of ICT in Life Sciences lessons. This is evident from the results chapter where all the participants agreed that they enjoy the use of ICT when teaching Life Sciences. For example, one of the participants (T6Aii) said that he enjoys using ICT a lot since it helps him to demonstrate concepts and processes in Life Sciences. This finding means that the teachers appreciate the use of ICT devices and they make use of them. This finding is very important in the South African context, because when teachers appreciate the use of the ICT devices available in South Africa; they are likely to be motivated to use them and to acquire the required skills for using the ICT devices effectively. The finding is not unique to this study because Krause *et al.* (2017) and Mahdum *et al.* (2019) also found that teachers have positive perceptions about ICT integration and integration in teaching and learning. Gunzo (2020) also had a similar finding that teachers perceive ICT as a method that transforms education to make teaching easy because it saves time and provides easy access to information. Contrary, Ramnarain *et al* (2023) stated that there is a complex relationship between teachers'

pedagogical perceptions and ICT integration, which influences teachers' teaching in Life Sciences.

However, the results of this study are contrary to studies that suggest that teachers have negative attitudes toward the integration of ICT (Mahat, Jamsandekar & Nalavade, 2012; Wang & Dostál, 2017). For instance, the findings from a study by Mahat *et al.* (2012) revealed that there was a negative attitude among teachers towards the use of ICT and they spent less time on ICT teaching. Similarly, Wang and Dostál (2017) revealed that negative attitudes of teachers towards the use of computers made them to be less likely to accept and adapt to educational ICT environments. In addition, Semerci and Aydın (2018) findings also illustrated that teachers' levels of anxiety in the use of ICT influences their attitudes towards their use. In this regard, it might be necessary to explore Life Sciences teachers' levels of anxiety towards the use of ICT as teaching and learning aids. Despite these contradicting findings, the finding from this study that teachers have a positive attitude towards the use of ICT in lessons offers hope for the integration of ICT in South African Life Sciences lessons, which is crucial for the improvement of the quality of education in South Africa.

5.2.2 Teachers' views about the contribution of ICT to teaching and learning.

The purpose of the second research question was to determine Life Sciences teachers' views about the contribution of ICT to effective teaching and learning of Life Sciences. The findings indicated that teachers are of the perception that ICT positively contributes to the teaching and learning of Life Sciences, by benefiting teachers in various ways. For example, the participants indicated that it affords them alternative ways of teaching and it caters for different learning styles. They further indicated that ICT helps with time management, in that they are able to cover a lot of content within a short time. The teachers also believe that ICT contributes to the learning of Life Sciences by enhancing learners' memory and it makes the subject fun. This finding reveals that ICT benefits teachers in various ways when teaching Life Sciences.

Teachers' awareness and appreciation of the contribution of ICT to the teaching and learning process in the South African context is another important finding because it implies that teachers are likely to be motivated to integrate ICT into their lessons. This

finding is similar to the finding by Nowfeek *et al.* (2021), where teachers perceived the use of ICT in lessons to be beneficial for effective teaching and learning, because they felt that the use of ICT helps both the teachers and learners to engage in lessons, and it arouses learners' interest in the lesson. It appears that teachers view the use of ICT as a motivational tool that creates engagement, excitement and it enables them to be creative (Nowfeek *et al.*, 2021). However, Adelabu and Adu (2014) and Krause *et al.* (2017) observed that the roles of ICT in teaching could only be effective when teachers have knowledgeable, appreciate and are competent in the use of educational ICT. In addition, a study conducted by Draper (2010) shows that when the ICT is accessible to science teachers in their classrooms, it is likely to be used effectively to develop and add value to the teaching and learning process. Draper (2010) further revealed that science teachers require a high technological pedagogical content knowledge to add utmost value to ICT integration in the teaching and learning process. In the next section, I discuss teachers' competence in the use of educational ICT.

5.2.3. Teachers' perceived competence in the use of educational ICT

The third research question was aimed at establishing Life Sciences teachers' competence in the use of educational ICT. The study findings suggest that the teachers consider themselves to be competent in the use of educational ICT. This is evident in the results chapter, where all the teachers indicated that they are confident in using ICT in the teaching of Life Sciences. For example, T4Ciii and T5Ciii said that they were 80 percent confident in the use of educational ICT. This finding implies that teachers are competent in using educational ICT when teaching of Life Sciences. The finding is significant because it could inspire education stakeholders, such as the Gauteng Department of Education and school principals, to provide the necessary ICT devices in Life sciences classrooms to support teachers.

It was necessary to determine the actual ICT competences of the teachers through lesson observations to triangulate the interview results. The lesson observations revealed that teachers were able to use available ICT devices such as the use of USB to upload slides on smart boards, connecting the laptop to the smart board using HDMI, browsing through Google to search for videos relevant to the lesson on YouTube. However, of the six

observed teachers, one could not show competence in the use of ICT because of a dysfunctional smart board, and his failure to make use of the available ICT.

Despite teachers' self-confessed competence in the use of ICT, lesson observations did not explicitly show teachers' competence in the actual integration of ICT into their teaching. This is because the teachers did not demonstrate the incorporation of computer-based interaction through videos, simulations, visual images and a wide range of technology-based tools into their classroom instructional processes (Ghavifekr & Rosdy, 2015). The findings from the current study is in accordance with Daling's (2017) findings that Biology teachers are competent in the use of ICT but their competence is at the proficient level. The proficient level relates to the knowledge, skills, and attitude that they possess regarding educational ICT use (Daling, 2017).

Other studies have found that most teachers are not competent in the use of ICT. For instance, the findings from Badau and Sakiyo (2013) showed that teachers' competency in ICT was low in numerous aspects, even though they are not specific to Life Sciences. In addition, this study's findings are also contrary to Ogechukwu's (2016) findings, which showed that most Biology teachers are not competent in the use of ICT. In this regard, Ghavifekr and Rosdy (2015) stated that ICT tools could go to waste if teachers lack the knowledge and skills required to use ICT.

The following section discusses the challenges faced by Life Sciences teachers when integrating ICT in their lessons.

5.2.4. The challenges faced by teachers when integrating ICT in Life Sciences lessons.

The fourth research question sought to identify challenges faced by Life Sciences teachers when integrating ICT into the teaching of Life Sciences. The findings of the study show that teachers face numerous challenges when attempting to integrate ICT into the teaching of Life Sciences. All the participating teachers mentioned numerous challenges that they face during the integration of ICT in their classrooms, such as; load shedding, electric cable theft, dysfunctional or unmaintained smart boards, lack of internet connectivity, and vandalism. For example, Teacher T6Div said that some of the

challenges that are letting them down in his attempts to integrate ICT in his lessons include the issue of load shedding and vandalism. During the lesson observations, teacher T6 could not use a smart board because it was dysfunctional due to poor maintenance. The dysfunctional smart board highlighted one of the challenges faced by the teachers in the use of ICT. This suggests that the teachers might not be successful in integrating ICT in the teaching of Life Sciences because of the challenges they face. The study finding is crucial because it provides an insight into the challenges that the stakeholders need to mitigate, in order to ensure successful integration of ICT in lessons.

Findings from several studies (Kola, 2013; Abdullahi, 2014; Belay *et al.*, 2020; Khalo, 2020) are similar to the findings of this study, as they show that teachers experience numerous challenges during ICT integration. The ICT integration challenges identified in the literature include; inadequate training for teachers, limited access to resources, lack of facilities, and unstable electricity due to load shedding. These studies (Kola, 2013; Abdullahi, 2014; Belay *et al.*, 2020; Khalo, 2020) are in accord with the findings by Ghavifekr and Rosdy (2015) who stated that teachers who are motivated to use ICT in teaching are discouraged by the insufficient support from the SMT. The finding from this study highlighted the need for stakeholders to provide appropriate mitigating measures for the identified challenges, in order to enhance the integration of ICT in Life Science lessons.

5.3. Limitations of the study

The sample size of the study was very small because it consisted of six teachers from six schools. Therefore, the findings cannot be generalized to Gauteng province Life Sciences teachers in South Africa. However, the findings could apply to schools with similar context as those involved in the study. The use of semi-structured interviews as a data collection tool and lesson observation posed a challenge, as teachers were not comfortable because they feared that the researcher would judge their language and teaching practices. In addition, COVID-19 regulations became a challenge, as teachers were not sure about meeting the researcher in person, as they were observing COVID-19 restrictions. However, with little encouragement, they agreed to participate in the interviews.

5.4. Conclusions

The first research question sought to explore the perceptions of Life Sciences teachers on ICT integration in Life Sciences lessons. In response to this question, it was found that the teachers have positive attitudes towards the integration of ICT in Life Sciences lessons. In relation to the second research question, which was meant to determine the views of Life Sciences teachers about ICT contribution to effective teaching and learning of Life Sciences. The finding from the study is that Life Sciences teachers think that ICT benefits them and their learners by affording them alternative ways of teaching, catering for different learning styles, and helps in time management, which are positive contributions to teaching and learning. The third research question explored the competency of Life Sciences teachers in the use of educational ICT. The finding shows that four of the six participating teachers claimed to be competent in the use of educational ICT, but the lesson observations did not explicitly show competence in the integration of ICT in lessons. Lastly, the fourth research question sought to identify the challenges that Life Sciences teachers face when integrating ICT into the teaching of Life Sciences. The finding of the study shows that teachers experienced several challenges when integrating ICT into the teaching of Life Sciences, which include; load shedding, electric cable theft, dysfunctional or unmaintained smart boards, lack of internet connectivity, and vandalism.

The primary research question for the study was aimed at exploring the integration of ICT in Life Sciences lessons. The findings indicate that teachers' attitudes and their perceptions about the contribution of ICT towards effective teaching and learning were not constraining factors towards the integration of ICT in Life Sciences lessons. However, several contextual factors faced by teachers could be some of the constraining factors in the integration of ICT in Life Sciences lessons. The problem that this study attempted to address is the inability of numerous schools to obtain high pass rates in the National Senior Certificate examination results in Life Sciences, despite the availability of ICT devices in the schools found in the Gauteng West district, in particular Merafong City. As stated above, contextual factors could partly account for the inability of schools to integrate ICT into Life Sciences lessons, which could affect pass rates in the National Senior Certificate examination results, in Life Sciences.

5.5. Implications of the study

The finding that teachers have positive perceptions on the integration of ICT in Life Sciences lessons suggests that teachers might be willing to integrate educational ICT into their lessons. The study also indicated that teachers perceive ICT to benefit them and their learners in various ways, which could motivate them to integrate ICT into their teaching of Life Sciences. The finding, which relates to the competence of teachers in the use of educational ICT, which is that some teachers were confident in the use of ICT, while others were not, and the limited use of ICT in observed lessons implies that the teachers might not be integrating ICT in their Life Sciences lessons effectively. This might disadvantage their learners, who would consequently perform poorly in assessments. Furthermore, the study found that teachers experienced several challenges during the integration of ICT in the teaching and learning of Life Sciences. This could further affect teachers' ability to integrate ICT into their lessons.

5.6 Recommendations

The study found that teachers have limited competence in the integration of educational ICT into their lessons. I therefore recommend that the Department of Education conduct workshops to train and motivate teachers in the use of educational ICT. The study findings also revealed that Life Sciences teachers face several challenges, such as; a lack of support in the integration of ICT. I recommend that the schools and the Department of Basic Education should provide more support to the teachers to help them integrate ICT into their Life Sciences lessons effectively. Another challenge is the lack of resources, load shedding, lack of relevant infrastructure, lack of Wi-Fi connectivity, and lack of maintenance of the necessary devices such as smart boards. In this regard, I recommend that the Department of Education build facilities that could enhance the use of ICT and improve access to the internet, as well as provide schools with backup generators to mitigate the effects of load shedding. Furthermore, the findings suggest that cable theft around the schools and vandalism pose a challenge to the integration of ICT. I recommend that the schools and Department of Education work closely with the members of the community, in particular community forums and the South African Police Service (SAPS), to combat this scourge. In addition, I recommend that each school be provided with surveillance cameras to deter offenders. Finally, it is also crucial to conduct further

research on the integration of ICT in Life Sciences lessons, involving many schools and teachers in order to establish the prevalence of the challenges identified in this study and the extent to which teachers are competent in the use of educational ICT.

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APPENDICES

APPENDIX A: SEMI-STRUCTURED INTERVIEW SCHEDULE

Title: An exploration of the integration of ICT in Life Sciences lessons: A case of Life Sciences teachers in Merafong city.

Researcher: Sajini Fenni

Interviewee code

Male	☐
Female	☐

INTRODUCTION.

Thank you for agreeing to participate in this discussion about a study exploring the integration of ICT in Life Sciences classes in Merafong city. My name is Sajini Fenni, and I am Masters student at the University of the Witwatersrand. The Masters course requires me to conduct research, and I would like to ask you some questions related to my research. In this interview, we shall discuss questions relating to: Life Sciences teachers' perceptions about the integration of ICT in the teaching of Life Sciences in Life Sciences lessons. We shall focus on: teachers' views about the contribution of ICT to effective teaching and learning of Life Sciences; teachers' competence in the use of educational ICT; and challenges faced by teachers when integrating ICT in the teaching of Life Sciences. There are no wrong or right answers in this discussion, but the information you provide will be valuable to my study and to the field of science education.

The interview will approximately last for approximately **30 minutes**, and it consists of a biography section and the main interview section. I will audio record the interview, so that I can listen to our discussion at a later stage, to capture your views correctly. All the information gathered from this interview will be kept confidential, and your identity and that of your institution will not be disclosed to the public. Furthermore, your responses to the interview questions will not be used against you in any way. You are therefore requested to feel free to say what you really think and how you real feel.

Please feel free to stop the interview at any point if you feel uncomfortable. Do you have any questions or comments, before we start?

SECTION 1. BIOGRAPHICAL DATA

1. Gender

2. What is your nationality

3. In which range does your age fall?

20 to 25 years	
25 to 30 years	
30 to 35 years	
Above 35 years	

4. What is your highest qualification?

B.Ed.	
B.Ed. Hons	
Masters	
PhD	

5. In which range does your teaching experience fall?

SECTION 2. INTERVIEW ITEMS

Theme 1: Life Sciences teachers' perceptions about integration of ICT in lessons.

1. When you think of ICT, what comes to your mind?
2. How would you describe your experience with the use of ICT in the teaching of Life Sciences?
3. Do you enjoy teaching using ICT in your Life Sciences lessons?
4. Do your learners enjoy learning using ICT?
5. Would you like your school and the department of education to support you more in the use of technology?

0 to 2 years	
2 to 5 years	
5 to 10 years	
10 to 15 years	
More than 15 years	

Theme 2: Life Sciences teachers' perceptions about the contributions of ICT to teaching and learning.

1. Do you think it is necessary to use educational ICT in the teaching of Life Sciences?
2. What do you think is the importance of using ICT in the teaching and learning of Life Sciences?
3. In what ways do you think the use of ICT could enhance the teaching and learning of Life Sciences?
4. Which areas of Life Sciences lessons do you think requires the use of ICT?
5. How could the use of ICT impact your teaching of Life Sciences?
6. What difference have you noticed (if any) in your learners' interest in the study of Life Sciences, before and after the use of educational ICT?

Theme 3: Life Sciences teachers' knowledge and competence in educational ICT.

1. Do you use ICT in your Life Sciences lessons?
2. How well are you accustomed with the use of educational ICT? (Beginner/proficient).
3. How confident are you in the use of educational ICT in teaching Life Sciences?
4. How often do you make use of the available educational ICT in the teaching of Life Sciences?
5. How familiar are you with the use of ICT in the teaching of Life Sciences?
6. Which ICT devices and resources do you use in your Life Sciences lessons?
7. Have you received any training in the use of educational ICT? How often?
8. What type of educational ICT training have you received?

Theme 4: ICT integration challenges faced by Life Sciences teachers.

1. How does your school environment support the use of ICT in lessons?
2. What educational ICT is available for use in your Life Sciences lessons?
3. What internal challenges do you often experience in the teaching of Life Sciences using ICT?
4. What external challenges do you often experience in the teaching of Life Sciences using ICT?
5. How easy is it for you to access educational ICT for use in your Life Sciences lessons?
6. Which educational ICT devices and resources are available in your school?

Would recommend the use of ICT in teaching Life Sciences? Explain.

It has been a pleasure talking to you. Thank you very much for your participation, patience and help. Your contribution is highly appreciated.

Thank you!

APPENDIX B: EXAMPLE OF INTERVIEW TRANSCRIPT

How would you describe your experience with the use of ICT in the teaching of Life Sciences?

T1Aii. My experience when I had the chance of teaching Grade 12 is that I was using the smart board, I had my slides prepared and found that it was very time saving. This is because Life Sciences is a subject that required a lot of notes so as a result since I had the smart board, slides prepared other than writing notes it save time and also it gave me the chance to show them the pictures and also videos because you can attach them to the slides and everything becomes easier.

T2Aii. It is very helpful; it is very helpful because we are doing away with these heavy textbooks. We are now using the internet. We are now using the images. We are now using the smart boards. We are now able even to communicate with our learners even if they are not in front of us using all these platforms like WhatsApp groups and all other things. So it is very helpful, because even in these smart boards we are able to see the images there and to see all these you moving images where you are able to show your DNA replication, they see it replicates on a moving image. It is very helpful on Life Sciences.

T3Aii. I have a good experience when teaching using ICT in Life Sciences since it's very efficient, since it uses different types of resources such as slides, videos, and also the notes that you prepared. And also it is useful because it shows nice diagrams which can assist both me and the learners in unpacking the lesson and also I think it make the lesson to be more clear because it prevents confusion. It make the lesson to be meaningful, yeah.

T4Aii. You know with me at my school, we are not so ICT friendly but over the years what I have seen is that or what has happened is that I usually use projectors to show them movies. I also use them to show them videos of concepts that are taught in Life Sciences and in that has in a way changed their perception and they have improved their performance in the subject. So that how I've done it in the past and how I continue to do it the challenges not the challenges purser but with the experience that I have.

T5Aii. It has been good so far. However, there is more room for development. We are attending teacher training workshops. There is a slot whereby we have training for ICT. So I'm still developing.

T6Aii. I would say my experience is little because during our days we never had this thing of ICT and I've tried to further my studies on ICT but time didn't allow me because

the college that I was trying to enrol with did not have that slotting time that will accommodate me just to upgrade myself in ICT. But, ICT has made things easier in Life Sciences.

APPENDIX C: OBSERVATION SCHEDULE

Name of Teacher:

Name of Observer: Sajini Fenni

Criteria: Observe the classroom environment, teacher's use of educational ICT, Teacher-learner interactions.

Key: VO= Very Often, O= Often, SM= Sometimes, S= Seldom, N= Never

1. Life Sciences teachers' knowledge and competence in the use of educational ICT.

No.	Elements observed	VO	O	SM	S	N
1.	Teacher uses ICT to promote active learning.					
2.	Teacher shows understanding of the use of appropriate ICT.					
3.	Teacher shows expertise in the use of ICT in the teaching of Life Sciences.					
4	Teacher shows positivity about the use of educational ICT in the teaching of Life Sciences.					
5	Teacher makes use of educational ICT to motivate learners' interest to the lesson.					
6	Teacher presents lessons using PowerPoint slides.					
7	Teacher uses multimedia such as simulations, images and videos to explain the scientific concepts and processes.					
8	Teacher created WhatsApp group for Life Sciences lessons.					

2. ICT integration challenges faced by Life Sciences teachers

No.	Elements observed	VO	O	SM	S	N
1	Teacher is well accustomed with the use of educational ICT.					
2	Teacher is confident in the use of educational ICT in teaching Life Sciences.					
3	Teacher makes use of available educational ICT in the teaching of Life Sciences.					
4	Teacher has access to educational ICT devices and resources.					
5	Teacher's school environment supports the use of educational ICT in the teaching of Life Sciences.					
6	The teacher struggles to use educational ICT during the teaching of Life Sciences in the classroom.					
7	Teacher experiences problems with external factor, such as electricity and WiFi, affecting the use of educational ICT in the lesson.					
8	The school has a tradition of using ICT in classrooms					

Name of researcher: Sajini Fenni.

Researcher's signature: 

Date: 03/07/2022

THE END

APPENDIX D: EXAMPLE OF OBSERVATION TRANSCRIPT.

Name of Teacher: Mpanza S.

Name of Observer: Sajini Fenni

Criteria: Observe the classroom environment, teacher's use of educational ICT, Teacher-learner interactions.

Key: VO= Very Often, O= Often, SM= Sometimes, S= Seldom, N= Never

1. Life Sciences teachers' knowledge and competence in the use of educational ICT.

No.	Elements observed	VO	O	SM	S	N
1.	Teacher uses ICT to promote active learning.			X		
2.	Teacher shows understanding of the use of appropriate ICT.		X			
3.	Teacher shows expertise in the use of ICT in the teaching of Life Sciences.		X			
4	Teacher shows positivity about the use of educational ICT in the teaching of Life Sciences.	X				
5	Teacher makes use of educational ICT to motivate learners' interest to the lesson.		X			
6	Teacher presents lessons using PowerPoint slides.			X		
7	Teacher uses multimedia such as simulations, images and videos to explain the scientific concepts and processes.			X		
8	Teacher created WhatsApp group for Life Sciences lessons.	X				

2. ICT Implementation challenges faced by Life Sciences teachers

No.	Elements observed	VO	O	SM	S	N
1	Teacher is well accustomed with the use of educational ICT.		X			
2	Teacher is confident in the use of educational ICT in teaching Life Sciences.	X				
3	Teacher makes use of available educational ICT in the teaching of Life Sciences.			X		
4	Teacher has access to educational ICT devices and resources.			X		
5	Teacher's school environment supports the use of educational ICT in the teaching of Life Sciences.				X	
6	The teacher struggles to use educational ICT during the teaching of Life Sciences in the classroom.					X
7	Teacher experiences problems with external factor, such as electricity and Wi-Fi, affecting the use of educational ICT in the classroom.	X				
8	The school has a tradition of using ICT in classrooms					X

Name of researcher: Sajini Fenni.

Researcher's signature: 

Date: 03/07/2022

APPENDIX E: PARTICIPANTS' INFORMATION SHEET



Dear Sir / Madam,

My name is Sajini Fenni and I am a Masters student in the School of Education, at the University of the Witwatersrand, Johannesburg. As part of my studies, I have to undertake a research project, under the supervision of Dr M.M.M. Kazeni, and I need Life Sciences teachers to participate in the study. The aim of this research project is to explore Life Sciences teachers' perceptions, competencies and challenges of integrating ICT in their lessons.

I would like to invite you to take part in a 30 minutes face-to-face interview, as part of my data collection process. During the interview, you will be required to answer some questions related to the integration of ICT in the teaching of Life Sciences. With your permission, I would also like to record the interview using a digital device.

There will be no personal costs to you if you participate in this project. You will not receive any direct benefits from participation and there are no disadvantages or penalties if you do not choose to participate or if you withdraw from the study. You may withdraw from the study at any time or choose not answer any question if you do not want to. If you experience any distress or discomfort at any point during the interview, we will stop it and resume another time. The interview and data obtained from class observations will be completely confidential and anonymous as I will not be asking for your name or any identifying information. Instead, I will be using a pseudonym to represent your participation in my final research report. The information you provide will be held securely in a password protected document, which will only be accessible by the researcher and the supervisor. If you need some support or counselling services following the interview, these are available free of charge at the Counselling and careers development Unit (CCDU): Tel – 011 717 9268 or E-mail - info.ccdtu.ac.za.

If you have any questions about this research, during or afterwards data collection, feel free to contact me or my supervisor using the details provided below. This study will be written up in a research report, which could be presented at a conference or published in a journal. If you wish to receive a summary of this report, I will be happy to send it to you. The data collected from this research project will be stored in a password protected document on a personal computer and will be kept for 5 years after the study. With your permission the data collected from this research project may be used by other researchers. If you have any concerns or complaints regarding the ethical procedures of this study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za

Yours sincerely

Sajini Fenni

CONTACT DETAILS

Researcher:

Name: Sajini Fenni

Signature 

Wits email: 725733@students.wits.ac.za

Phone number: 0717533661

Supervisor:

Name: Dr. M.M.M. Kazeni

Signature 

E-mail: monde.kazeni@wits.ac.za

Phone number: 011 717 3073

APPENDIX F: CONSENT FORM FOR PARTICIPANTS



Dear prospective participant,

Kindly complete this form to indicate your willingness to participate in this research project.

Title of project: An exploration of the integration of ICT in Life Sciences lessons: A case of Life Sciences teachers in Merafong city.

Name of researcher: Sajini Fenni.

I,, agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

I agree that my participation will remain anonymous	YES	NO
---	-----	----

I agree that the researcher may use anonymous quotes in his / her research report	YES	NO
---	-----	----

I agree that the interview may be audio recorded	YES	NO
--	-----	----

I agree that the information I provide may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained.	YES	NO
--	-----	----

I confirm that I been informed of my right to withdraw from the study and not to answer any questions that I am uncomfortable with.	YES	NO
---	-----	----

Name of participant.....

Participant's signature

Date

Name of researcher: Sajini Fenni.

Researcher's signature: 

Date: 03/07/2022

APPENDIX G: CONSENT FOR AUDIO RECORDING OF THE INTERVIEW



Study title: An exploration of the integration of ICT in Life Sciences lessons: A case of Life Sciences teachers in Merafong city.

RESEARCHER: Sajini Fenni.

Dear participant,

As indicated in the consent letter for participation in this study, with your permission, I would like to audio record the interview using a digital device. This recording will be stored on an electronic device, and only the researcher will have access to this recording. The recording will be deleted five years after the completion of the study. If you consent to the recording of the interview, kindly complete the consent statement below.

I,, agree to be audio recorded in the interview of this research project that I am participating in. The research has been explained to me and I understand what my participation will involve.

Name of participant

Signature of participant

Date

Sajini Fenni

A handwritten signature in black ink, appearing to be 'Sajini Fenni', written over a horizontal line.

Date: 03/07/2022

APPENDIX H: LEARNERS' ASSENT LETTER FOR LESSON OBSERVATIONS



Dear learner,

RE: Request for assent to observe lessons

My name is Sajini Fenni and I am the Master of Education student at the University of the Witwatersrand. One of the requirements of the Masters programme is to conduct research. My research is titled: Exploring Merafong City Life Sciences Teachers' Perceptions, Competencies and Challenges of Integrating ICT in their lessons. This study requires me to observe your teacher twice, to learn how s/he teaches Life Sciences using educational ICT. During the lesson observation, I will not participate in any of the class activities and you will not be required to answer any questions from me. I will just sit in your classroom quietly and observe how your teacher teaches Life Sciences using educational ICT. My observation of your class will not advantage or disadvantage you in any way. The information that I will collect from the observations is likely to help me and other people to understand the teaching of Life Sciences better using ICT, which might help teachers to teach the subject effectively.

I request you to allow me to sit in two of your Life Sciences lessons. The lessons will be audio recorded so that I can capture the required information accurately. Your identity and that of your teacher and your school will not be revealed in the research report that I will write. You have the right to refuse to be observed, and you will not be punished for refusing. Please sign the assent form below, if you allow me to sit in your classroom.

=====

ASSENT FORM

I (Name of learner), willingly allow the researcher: Mr Sajini Fenni to sit in my class and observe two Life Sciences lessons. The research has been explained to me and I agree to the following:

(Please tick the relevant options below).

I agree that I will not be actively involved in his study.	YES	NO
--	-----	----

I agree that the researcher will not ask me any questions.	YES	NO
--	-----	----

I agree that the lesson observation may be audio recorded.	YES	NO
--	-----	----

I confirm that I have been informed of my right to refuse the request to allow the researcher to observe the classroom where I am.

YES

NO

Name of participant: -----

Participant's signature: -----

Date: -----

Name of researcher: Sajini Fenni

Researcher's signature: 

Date: 03/07/2022

APPENDIX I: PERMISSION LETTER TO SCHOOL PRINCIPALS



From: Sajini Fenni

University of the Witwatersrand,

Wits School of Education, Science Education

011 717 3260

29 September 2022

Dear Sir,

Re: Permission to conduct research.

My name is Sajini Fenni.

I am a student studying for a Master of Education degree in the Wits School of Education at the University of the Witwatersrand. I am seeking permission to do research at your school, if you allow me.

I am conducting research on the Life Sciences Teachers' Perceptions, Competencies and Challenges of Integrating ICT in their lessons. The main reason for conducting this study is that most Life Sciences teachers struggle to produce good results despite the availability of ICT in their schools, which are perceived to enhance learner performance. Hence, the aim of the study is to explore Life Sciences teachers' perceptions, competencies and challenges that could affect the integration of ICT in the teaching of Life Sciences in schools in Merafong city.

Data will be collected from Life Sciences teachers through the use of face to face semi-structured interviews and 2 lesson observations per teacher. The semi-structured interviews will last for approximately 30 minutes per participant, and they will be conducted **after school hours, so that I do not interfere with the school timetable**. All interviews will be audio recorded for reference later on. Lesson observations will be conducted during school hours to observe the use of ICT in the lessons.

Participants will be required to give their written consent before the research begins. Their responses will be treated **confidentially, and identities (their names and the name of their institutions) will be anonymous**. Anonymity and confidentiality will be maintained in all published and written data, resulting from the study. The results of the study will be communicated in a research report and each participant will be provided with a copy of the transcripts for transparency and to ensure accurately representation of their responses.

The research participants will not be advantaged or disadvantaged in any way. The participants will not be paid for participating in this study. They will be assured that they can withdraw their permission to participate in the study at any time during this project, without any penalty. There are no foreseeable risks in participating in this study. All research data will be destroyed five years after the completion of the study.

I request your permission in writing, to conduct my research at your institution. The permission letter should be on your institution's headed paper, signed and dated, and specifically referring to myself by name and the title of my study. If you allow me to conduct my research in your school, kindly provide your consent details below. Please let me know if you require any further information. I look forward to your response as soon as is convenient.

Name of Principal.....

Signature of Principal

Date

Yours sincerely,

Name: Sajini Fenni.

Signature: 

Tel No: 0717533661.

Email address: 725733@students.wits.ac.za.

Supervisor

Dr Monde Kazeni



0117173073

Monde.kazeni@wits.ac.za

APPENDIX J: ETHICS CLEARANCE CERTIFICATE

UNIVERSITY OF THE
WITWATERSRAND
JOHANNESBURG



WSoE
Wits School of Education

SCHOOL OF EDUCATION ETHICS COMMITTEE

CONSTITUTED UNDER THE UNIVERSITY HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)

CLEARANCE CERTIFICATE

PROTOCOL NUMBER: 2022ECE045M

PROJECT TITLE

Exploring the Constraints of Implementing ICT:
A case of Life Sciences Teachers in Merafong
city.

INVESTIGATOR

Fenni Sajini

SCHOOL/DEPARTMENT OF INVESTIGATOR

WSoE

DATE CONSIDERED

10 August 2022

DECISION OF THE COMMITTEE

Approved unconditionally

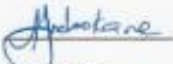
RISK LEVEL

No Risk

EXPIRY DATE

Date of submission of the Research Report

ISSUE DATE OF CERTIFICATE

CHAIRPERSON 

Dr. Batseba Mofolo-Mbokane

cc: Dr. Monde Kazeni

DECLARATION OF INVESTIGATOR

To be completed in duplicate and **ONE COPY** returned to the Chairperson of the School/Department ethics committee.

I fully understand the conditions under which I am authorized to carry out the abovementioned research and I guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee.


Signature

Date 23 / 08 / 2022

APPENDIX K: GDE RESEARCH APPROVAL LETTER



GAUTENG PROVINCE

Department: Education
REPUBLIC OF SOUTH AFRICA

R/4/4/1/2

GDE RESEARCH APPROVAL LETTER

Date:	19 July 2022
Validity of Research Approval:	08 February 2022– 30 September 2022 2022/317
Name of Researcher:	Fenni S
Address of Researcher:	5 Monazite Street Carletonville
Telephone Number:	071 753 3661
Email address:	sajinifenni@gmail.com
Research Topic:	Exploring the Constraints of Implementing ICT: a Case of Life Sciences Teachers in Merafong city.
Type of qualification	MASTERS' OF EDUCATION
Number and type of schools:	8 Secondary Schools
District/s/HO	Gauteng West

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 are met. Approval may be withdrawn should any of the conditions listed below be flouted:

Making education a societal priority

Office of the Director: Education Research and Knowledge Management

7th Floor, 17 Simmonds Street, Johannesburg, 2001

Tel: (011) 355 0438

Email: Faith.Tshabotale@gauteng.gov.za

Website: www.education.gpg.gov.za

1. The letter 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. **Because of the relaxation of COVID 19 regulations researchers can collect data online, telephonically, physically access schools, or may make arrangements for Zoom with the school Principal. Requests for such arrangements should be submitted to the GDE Education Research and Knowledge Management directorate.**
4. **The Researchers are advised to wear a mask at all times, Social distance at all times, Provide a vaccination certificate or negative COVID-19 test, not older than 72 hours, and Sanitise frequently.**
5. 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 has been granted permission from the Gauteng Department of Education to conduct the research study.
6. A letter/document that outlines 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.
7. The Researcher will make every effort to obtain the goodwill and cooperation of all the GDE officials, principals, and chairpersons of the SGBs, teachers, and learners involved. Persons who offer their cooperation will not receive additional remuneration from the Department while those that opt not to participate will not be penalised in any way.
8. Research may only be conducted after school hours so that the normal school program 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.
9. 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.
10. 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.
11. It is the researcher's responsibility to obtain written parental consent of all learners that are expected to participate in the study.
12. The researcher is responsible for supplying and utilising his/her 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.
13. 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.
14. 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.
15. 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.
16. 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 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. Gumani Mukatuni

Acting CES: Education Research and Knowledge Management

DATE: 19/07/2022

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Making education a societal priority

Office of the Director: Education Research and Knowledge Management

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APPENDIX L: TURNITIN REPORT

Research Report Final Submission.docx			
ORIGINALITY REPORT			
7%	4%	8%	2%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS
PRIMARY SOURCES			
1	Malope, Memory L.. "Comparing the Technological Pedagogical Content Knowledge-Practical Proficiency of Novice and Experienced Life Sciences Teachers", University of Johannesburg (South Africa), 2022 Publication	2%	
2	hdl.handle.net Internet Source	1%	
3	Relela, Mokgadi Elizabeth. "Life Sciences Teachers' Pedagogical Content Knowledge when Addressing Socioscientific Issues Embedded in Evolution", University of Johannesburg (South Africa), 2023 Publication	1%	
4	Submitted to University of Fort Hare Student Paper	1%	
5	Smeets, E.. "Does ICT contribute to powerful learning environments in primary education?", Computers & Education, 200504 Publication	1%	
6	"Pedagogy and ICT Use", Springer Science and Business Media LLC, 2008 Publication	<1%	
7	"Fast forwarding Higher Education Institutions for Global Challenges", Springer Nature, 2016 Publication	<1%	
8	Submitted to Midlands State University Student Paper	<1%	