THE CHALLENGES FACED BY GRADE 7 MATHEMATICS TEACHERS IN INTEGRATING DIGITAL TECHNOLOGIES TO TEACH DATA HANDLING

by

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submitted in accordance with the requirements for the degree of

MASTER OF EDUCATION

in the subject

MATHEMATICS EDUCATION

at the

UNIVERSITY OF SOUTH AFRICA (UNISA)

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DECEMBER 2023

DECLARATION

I hereby declare that THE CHALLENGES FACED BY GRADE 7 MATHEMATICS TEACHERS IN INTEGRATING DIGITAL TECHNOLOGIES TO TEACH DATA HANDLING is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. I further declare that I have not previously submitted this work, or part of it, for examination at UNISA for another qualification or at any other higher education institution.

_____ _____

Signature **Date**

DEDICATION

I dedicate this study to my entire family, including my mom, my late dad, my siblings and my children, Prince Jesaja Tangi-Tate and Johannes Etuhole. I also dedicate my study to my grandmother Kuku Ndatelela Shimweefeleni, my late grandfathers, Tatekulu Andreas Shilongo Mwalyombu and Tatekulu Paulus Nghiimodino Nghuulili and my late grandmother, Kuku Lovisa Namalwa Amutenya.

ACKNOWLEDGEMENTS

Firstly, I want to express my gratitude and praise to God Almighty for His many blessings that have allowed me to successfully finish my study.

I also would like to sincerely thank the following people and institutions for their assistance in getting this study finished:

For her genuine and professional academic assistance, direction, and advice, I am grateful to my supervisor, Dr. Motshidisi M. Masilo. Her perseverance, genuineness, and drive have greatly motivated me. It was an immense honour and joy to work and learn under her direction. She has been the most reliable source of support and motivation. I am so grateful for her guidance that words cannot describe how much I appreciate it; may the Almighty God continue to increase her knowledge and academic successes.

My fiancée, Ms. Klaudia Hendrina Hangula, has been an inspiration to me during this education. She has convinced me to stay up late working on this study till it is finished. I appreciate your confidence in me and your support in getting me to achieve this great step.

I am grateful to Mr. Isak Hamatwi, the director of Ohangwena Educational, and Mr. Crispin Masule, the Otunganga Circuit Inspector, for allowing me to gather my data in Otunganga Circuit. The participating schools' principals who gave me permission to carry out this study in their schools.

I am also appreciative of the teachers and pupils that took part in my research. This study was shaped by your participation, and I could not have carried it out without you. God bless you all, the time we have spent together has been incredible.

- Lastly, I would want to thank my friends, coworkers, and complete family for their kind words and unwavering support. I have persisted without giving up because of you. I

appreciate you giving me the much-needed time apart so that I can actually complete my research.

ABSTRACT

This study explored the challenges faced by mathematics teachers in integrating digital technologies in teaching Data handling in Grade 7 in Ohangwena Region, Namibia. In this digital era, it is crucial for teachers to realise the significant role that technologies play in learners' performance. A qualitative case study approach was adopted for this study. The sample includes two (2) Grade 7 Mathematics teachers and twenty-six (26) Grade 7 Mathematics learners. Semi-structured interviews and observations were used to collect data. Data from interviews and observations were analysed using deductive thematic analysis and the TPACK theory guided this study. The results of this study show that teachers are faced with several challenges in integrating technology in teaching. The challenges include the inadequate technological skills in teachers on integrating technology in teaching, insufficient technological tools in schools, negative perspectives among teachers towards the utilisation of technology to teach and limited scope on the integration of technology in the curriculum. This study thus recommends the provision of sufficient digital tools in schools. The study also recommends that in-service teachers be provided with continuous professional development to improve the technical skills and sufficient training of pre-service teachers on technology integration in teaching Mathematics. It is further recommended that curriculum developers need to revise the curriculum and improve it to accommodate technological integration in teaching.

Key terms: Digital technologies, Mathematics, Data handling, Circuit, Content Knowledge, Pedagogical Knowledge, Technological Knowledge

ACRONYMS

B. Ed	Bachelor of Education (Honours)
BETD	Basic Education Teaching Diploma
CIA	Computer-Aided Instruction
CK	Content Knowledge
CPD	Continuous Professional Development
DoE	Directorates of Education
IC	Information Communication
ICT	Information and Communication Technology
MCA	Millennium Challenge Association
MCAN	Millennium Challenge Account Namibia
MoE	Ministry of Education
MoEAC	Ministry of Education Arts and Culture
NGO	Non-Governmental Organisations
NIED	National Institute for Educational Development
NSHE	Natural Science and Health Education
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
SCL	Student-Centred Learning
STAs	Standardised Achievement Tests
TCK	Technological Content Knowledge
TK	Technological Knowledge
TPACK	Technological Pedagogical and Content Knowledge
TPCK	Technological Pedagogical Content Knowledge
TPK	Technological Pedagogical Knowledge

UNAM	University of Namibia
UNISA	University of South Africa

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CHAPTER 1
OVERVIEW

1.1 Introduction

As we navigate through the 21st century, the integration of digital technologies in education is not just a trend but a necessity. In the realm of mathematics, the ability to handle data effectively is crucial for students' future success. However, teachers face a myriad of challenges in incorporating these technologies into their curriculum, particularly in Grade 7, where foundational skills are being cemented. According to Prestridge (2012) the challenges include teachers' theoretical beliefs, and these beliefs affect how they teach learners. The methods and tools that the teachers employ to teach depend on their beliefs, be it traditional or belief system aligned with the digital era. Digital technology includes Information and Communication Technology (ICT) and digital tools such as computers, computer software, smartboards and projectors which are involved in teaching and learning methods in the digital era. Mukasa-Lwanga (2018) argues that, at present, technological advances have changed the way individuals live and the way things are done, and this includes education where teaching and learning should improve through the incorporation of technology. Additionally, Mukasa-Lwanga (2018) points out detailed challenges regarding how scholastics are expected to obtain adequate knowledge. The knowledge that involves innovations utilised in teaching, and the lack of knowledge on available technologies may lead to unsatisfactory incorporation of technology in teaching and learning.

Considering this, this study explored the challenges faced by Grade 7 Mathematics teachers on integrating digital technologies in teaching the topic of *Data handling*, and the perspectives of integrating digital technology into their presentations. The data handling topic in Grade 7 requires learners to become competent in several stages to solve data handling related

problems. For example, to engage problem-solving, learners must know (1) data collection and organising; (2) representation of data using various graphs, including pie charts; and (3) interpreting graphs and data, summarising and reporting. Teachers can integrate digital tools, such as computers and relevant Mathematics software, to teach the topic, especially at stage 2, where digital expertise can be used to represent data graphically. However, Achary (2011) reported that Mathematics as a subject that has been always slow to adopt technological innovation, still faces the challenges of effective technology integration in teaching and learning. Nine years later, Appavoo (2020) reported that there are still a few numbers of teachers who integrate technology in teaching mathematics. The findings in Achary's study emerged from examining the effectiveness of computer-aided teaching on the quality of learning data handling in Mathematics in Grade 7 in South African schools.

According to the Technological Pedagogical Content Knowledge (TPACK) theoretical perspective, teachers' knowledge of content is interrelated with pedagogy skills that affects the use of teaching technologies (Koehler & Mishra, 2006). In the digital era, teachers should make the maximum use of digital resources to meet the needs of learners who are digitally inclined. Nonetheless, the interrelation of digital resources and pedagogy is clustered with challenges. This study assumes that the mathematics teachers' challenges in integrating technology impact on the learning process of Mathematics learners. In support of this, Moore (2012) suggests that one of the alternative strategies for improving student achievement and motivation in Mathematics is to integrate technology in teaching and learning. This study suggests that curriculum developers and Mathematics book writers should encourage the incorporation of pedagogies and strategies that integrate successful Mathematics lesson presentations with digital technologies.

The study was underpinned by the Technological Pedagogical Content Knowledge (TPACK).

This theory encapsulates the three types of knowledge that the teacher may use during the delivery of a lesson, namely, content knowledge – knowing and understanding what you are teaching; pedagogical knowledge – knowing the best strategies to use in lesson presentation; and technological knowledge – having knowledge of the best digital technological tools to integrate in the presentation (Koehler & Mishra, 2009). The researcher selected this theory, based on its emphasis on integrating technological knowledge in teaching, to successfully integrate digital technologies. The purpose of this study was to explore the challenges faced by mathematics teachers when using their subject-matter expertise in a digitally resource-rich mathematics learning environment. This study was undertaken with a focus on Namibian mathematics education in the digital age.

1.2 Background for the study

Education professionals require professional development resources, such as computers, overhead projectors, smartboards and internet access, to create curriculum-specific instructional content that is informed by pedagogy in order to implement protocols for the integration of educational technology (Christopoulos & Sprangers, 2021). Digital technology has become a crucial part of many sectors of life including the education system. Yet, its integration in teaching may be an obstacle for many teachers. The researcher's viewpoint is supported by Hyndman (2018) who argues that teachers often struggle to use laptops.

While there are elevated expectations for teachers to incorporate technology in classroom presentations, Hyndman (2018) points out that teachers face challenges in relation to technology such as fulfilling the needs of digital-era learners and engaging teachers in adequate professional development to become skilled in digital technology. This background looks at the implications of technology in diverse teaching and learning environments as well as the

enhancement of learning towards improving learners' performance in data handling.

1.2.1 Technological implications in diverse teaching and learning environments

Technology integration plays a vital role in the teaching and learning process. Yet, the successful integration of technology in teaching and learning faces various challenges in countries around the world. To compare the challenges with Namibian schools, this section examines some research conducted throughout the world.

Technology is more popular in developed countries than in developing countries. For example, Herold (2015) reported that in the United States, public schools now provide at least one computer for every five students, but there is limited evidence to show that it is improving learning outcomes for most students. In a more recent report, Francom, Lee, and Pinkney (2021) reported that 62 per cent of classrooms are scaled to be 1:1 (featuring a tablet/computer for each student), and although 38 per cent indicated that their classrooms were not on a 1:1 scale, 66 per cent of learners had internet and computer access sufficient for learning, and 65 per cent had computer access. According to Fuglestad (2011), Norwegian upper secondary schools have 1.8 students per computer on average, whereas primary and lower secondary schools have an average of 4.7 students per computer and 90 per cent of computers and 98 per cent of PCs can access the internet.

In South Africa's Limpopo Province, Moila (2006) researched the integration of ICT in Mathematics teaching and learning in a rural school to find out whether there is a connection between the use of ICT and the accomplishments of learners. The study concluded that there is a lack of educational technology tool integration in teaching and learning Mathematics, a lack of training for educators on the use of education and learning technologies, and a lack of educational tools in rural schools. In a study conducted in Jordan by Alkawaldeh and Menchaca

(2014), the barriers to utilising ICT for teaching and learning were explored and the study indicated that 15 barriers were found and were related to “facilitating conditions”. The study suggested additional institutional support for schools and improved professional and pedagogical instruction for teachers.

According to a report published in Norway, Ekberg and Gao (2018) discovered that the viewpoint of teaching and teaching preparation were linked to the largest obstacles to technology integration in the classroom. Additionally, their investigation revealed a few brand-new difficulties. For example, the findings showed that identifying student work that was plagiarised took time and that there was insufficient ICT training for the digital materials that the schools supplied. Beswick (2021) emphasised that teaching in general and with digital resources is a challenging task for teachers; it requires a deep insight into the subject, knowledge of digital technologies and an understanding of the thoughts of pupils. It also includes pedagogical methods and connects them to the curriculum plans and policies involved in a dynamic evolving environment. Beswick (2021) further explains that the application of technology or, more specifically, digital technology, in teaching, involves not only learning how to use computers, software and other digital tools, but also involves technology in other fields of information, pedagogy and content knowledge. Molnár (2008) states that the rapidly increasing influence of technology in the 21st century has led to demands for teaching and learning to be changed to prepare learners to succeed in the global information economy. Learning in the 21st century includes the engagement of well-trained teachers, working in well-equipped classrooms and creatively using technology to facilitate learning in a positive learning environment.

1.2.2 Technological integration in the Namibian curriculum

As a developing country, Namibia has also prioritised the advancement of technology in the education system. The then Ministry of Education (MoE) implemented the ICT policy of Education in 2005 that prioritises the incorporation of technology in teaching and learning situations (ICT Policy, 2005). Currently, the policy is reinforced by the Ministry of Education, Arts and Culture (MoEAC). Studies done by Afunde (2015) and Simataa (2015) in Namibia also indicate that the establishment of ICT policy and recent measures to increase investment in ICT facilities are evidence that the Namibian Government recognises the value of ICT in education. However, the country faces challenges in terms of successful technology integration in teaching. Simataa (2015) indicates that the transformation of education systems in terms of technology is a challenge to developing countries such as Namibia even though most schools in Namibia are equipped with digital technology tools, referred to as electronic tools, programmes, devices, and services that produce or store data.

When Namibia gained independence, education system has gone through changes to find and offer quality education to the nation (Simataa, 2015). Among others, technology integration in the education system has been one of the aspects that have been at the centre of curriculum improvement. Namibia's Vision 2030 is that the country should be a knowledge-based society, where knowledge is created, transformed, and used for innovation to improve the quality of life. Education is regarded as the cornerstone of achieving the envisaged goals. An integral part of this approach is the integration of ICT as a tool to enhance teaching and learning. The vision expects all schools to be at ICT Level 2 (ICT Policy, 2005) which means that a school has one room with ICTs, audio-visual and broadcast facilities, and internet connectivity and that all teachers have the Foundation Level ICT certification and at least two staff members with Advanced Level ICT literacy Certification or a higher ICT qualification. The learners should

have access to ICT literacy for at least one class period (ICT Policy, 2005).

Another goal of the policy's implementation is to improve teachers' and learners' information communication skills to support the vision of a knowledge-based society (ICT Policy, 2005). However, critics have claimed that the improvement is too far-reaching and unsustainable so far. A local newspaper reported in 2022 that the requirement for achieving Level 2 in schools is being hampered by factors such as the fact that most schools lack these rooms and, if they do have them, the equipment is not used due to the attitude of teachers and the pressure from the curriculum to teach and assess all the competencies of the most crucial subjects, known as "promotional." As a result, not much is done in some schools to teach or even evaluate ICT. The report thus calls for the MoE, together with curriculum developers to realise how crucial the subject ICT is in the development of the country as well as the realisation of a knowledge-based society for Namibia's Vision 2030, or else learners will continue to struggle with ICT at universities and workplaces because they were not properly exposed to the sector (Jacobs, 2022).

The then Minister of Education was reported in another local newspaper in 2017 pointing out that one of the factors affecting the roll-out of widespread and high-quality ICT education is the absence of ICT training for teachers. This means that suitable professional development programmes are not accessible for educators to use ICT in a pedagogically meaningful manner (Prinsloo, 2017).

The implications of technological integration in teaching have been studied in various countries. The results show that technological integration remains a challenge for teachers across many countries, even though it is a very useful aspect in the teaching and learning process. Namibia is no exception to these challenges. While most of the studies rarely looked

at the challenges faced by teachers when integrating technology in teaching Data Handling, this study explored these challenges in the Namibian context and suggests viable solutions while employing the ideas and suggestions made in other studies in other countries. This study contextualised the integration of technology with teaching Data Handling in Grade 7 Mathematics using a computer and a projector to teach as technological instruments. This study took place at the schools' computer labs where the rooms are equipped with a computer and a projector rather than in the normal classrooms since the classrooms are not equipped with the technological tools.

1.2.3 Learners' performance in Data handling in Namibian schools

Naidoo and Mkhabela (2017) argue that data handling plays a significant role in exposing learners to real-life situations. However, in a study was done under the National Institute for Educational Development (NIED) in Namibia, Nambira et al. (2009) reported that it as one of the poorly performed topics in Grade 7. Their report is derived from the results of the institute through the Standardised Achievement Tests (STAs) which were administered to the Grade 5 and 7 learners nationally every year. The study was conducted to understand the difficulties experienced by learners under the topic data handling. The STAs were conducted on three subjects: Mathematics, Natural Science and Health Education (NSHE), and English to the Grade 5 learners of the previous year (currently in Grade 6), and Grade 7 learners (currently in Grade 8) in the first semester of the year. However, due to the Covid-19 pandemic, they have not been administered since 2020.

For better understanding, Nambira et al. (2009) engaged teachers as well through a questionnaire to give their opinions on what could be the cause of learners' difficulties in the topic. Figure 1.1 shows their participants' perceptions on the difficulties experienced by

learners in different Data handling competencies. Nambira et al. (2009) interpreted the figure as the teachers' opinions on competencies with data handling in which learners experience difficulties.

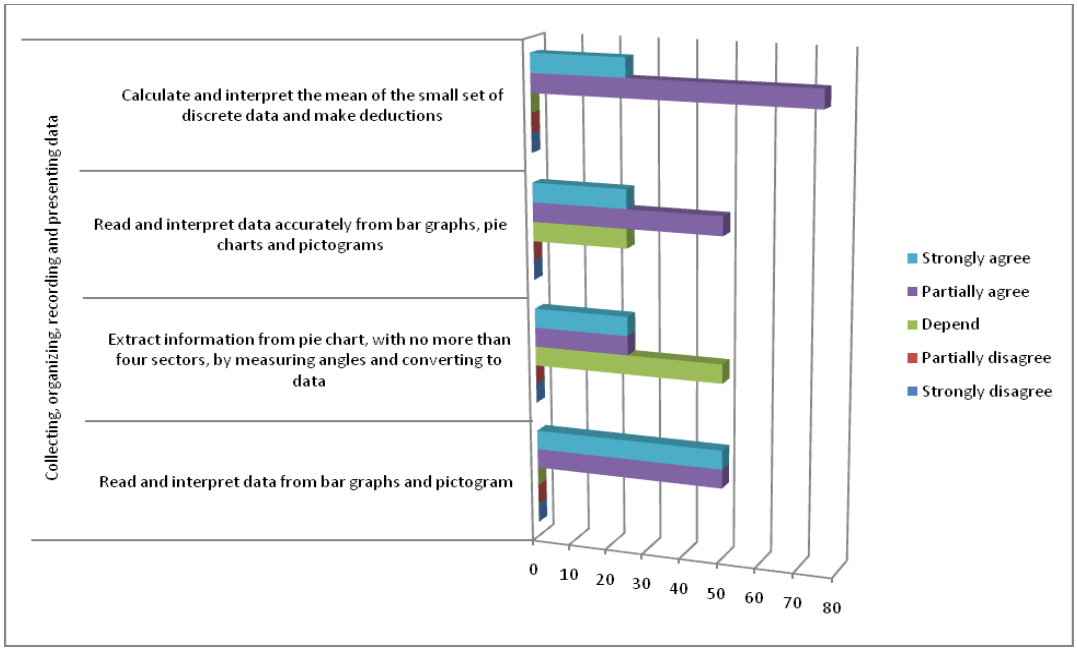


Figure 1.1: Competencies in data handling (Nambira et al., 2009:83)

According to the figure, learners experience difficulties in collecting, organising, recording and presenting data. The figure further shows that, although the difficulties were observable under all competencies, they were observed more under reading and interpreting data from bar graphs and pictograms. It shows that about 50 percent of the teachers responded to the scale of strongly agree to partially agree. Moreover, about 50 per cent of teachers agreed that learners also experience difficulties with calculating and interpreting the mean of the small set of discrete data. The data in the figure further shows that there were obvious difficulties in reading and interpreting data accurately from bar graphs, pie charts and pictograms with 50% of the teachers agreeing with the notion.

As shown in Figure 1.1, data handling is one of the challenging topics in the Grades 5 to 7

Mathematics content. However, since the STAs were set to test all the topics of the subject, the recommendations were generalised to poor performance of the subject. Nonetheless, the recommendations given by Nambira et al. (2009) can be applied to tackle poor performance in each topic, including data handling. The recommendations include upgrading teachers' strategies for higher grades, ensuring consistent support from Advisory Teachers, reviewing Upper Primary Mathematics syllabuses and offering intensive CPD training programmes by NIED.

These recommendations ought to be based on the fact that teachers play a significant role in the performance of learners in the subject. Thus, this study assumes that poor performance on the topic data handling is due to several challenges that may include technology integration in teaching and learning. The challenges include teachers' limited knowledge on technology as a teaching strategy, unavailability of digital resources in schools and perspectives towards the integration of technology in teaching and learning.

Although the integration of technologies in teaching is necessary in the current world, this study noted that there are drawbacks that teachers experience with the integration of technology into their lessons. The researcher in this study believes that little research has been conducted about the integration of technology, specifically for teaching data handling in Mathematics. Studies done in countries, such as South Africa, Norway, Jordan, Malaysia, and Namibia, mostly conclude that the integration of ICT and digital technologies in the teaching of Mathematics has not been explored, specifically in data handling.

1.3 Problem statement

In an attempt to improve the education system in Namibia, an ICT policy for education in Namibia, was implemented in 2005 with the main objective, to integrate ICT across the

curriculum (ICT Policy, 2005). The policy was a supplement to the conceptual framework on the paradigm changes from the conventional teacher-oriented teaching and learning to learner-centred approaches which was implemented in 2003. The framework was passed since learner-centred education was introduced in 1991 as a foundation policy for the new educational system of Namibia, and there have been different understandings of what is meant by learner-centred education and how to put it into practice (Learner-Centred Education, 2003). The implemented policies have been rarely criticised on their effectiveness in schools. Mutilifa (2017) however, investigated the effectiveness of the learner-centred approach in teaching Grade 11 Science in two Namibian schools in Ohangwena Region and concluded that a learner-centred approach improves learners' performance in comparison to teacher-centred teaching. Ngololo et al. (2012) also evaluated the implementation the ICT policy in rural science classrooms and concluded that its use is low. The implementation of policies in the Namibian education system indicate that the country is doing something to overcome poor performance in teaching and learning. There is however, limited scope on specific subjects and topics and data handling as a topic is no exception to this scope.

The incorporation of digital technologies in teaching and learning provides an opportunity for educators to move away from teacher-centred learning (Boning & Xuedan, 2020; Klimova et al., 2023; Skaik & Tumpa, 2022). Furthermore, Klimova et al. (2023) argue that emerging technologies, such as artificial intelligence and big data processing, have affected education processes and pedagogy, including the strategies and approaches related to teaching and learning. The reviewed studies show that teachers need to incorporate digital technology into their teaching as a way to overcome poor performance in teaching and learning. Several studies, such as those of Hyndman (2018), Moila (2006), Alkawaldeh and Menchaca (2014), and Fuglestad (2011), have described difficulties faced by teachers in incorporating digital

technology in teaching Mathematics. The studies have however, focussed on Mathematics as a subject and less focus on data handling as a topic.

As shown in Figure 1.1, data handling is difficult for most learners. Although data handling is one of the underperformed topics in Grade 7, no relevant study was conducted either in Namibia or other countries on the challenges of incorporating digital technology in Grade 7 to teach data handling. Studies have either been generalised to ICT inclusion in all subjects, for example, generalisation focusing on (1) the incorporation of computer technology as digital technology in teaching and learning; (2) barriers related to the use of ICT; (3) teachers' knowledge of digital resources, and (4) teachers' experience in teaching data handling (ICT Policy, 2005; Simataa, 2015; Naidoo & Mkhabela, 2017). There is limited scope on the utilisation of digital technology as an appropriate approach that teachers can employ in the digital era to overcome challenges in teaching and learning of data handling.

In the evolving educational landscape of Namibia, Grade 7 teachers are increasingly expected to integrate digital technologies into their teaching methodologies to enhance data handling competencies among students. However, this integration presents multiple challenges that can impede the effective delivery of curriculum objectives. This study aims to explore the specific barriers faced by Grade 7 teachers within the Namibian context, such as limited access to technological resources, inadequate training in digital pedagogy, and the absence of a supportive infrastructure. By identifying and understanding these challenges, the study seeks to contribute to the development of strategic interventions that can facilitate a more seamless adoption of digital technologies in teaching data handling, ultimately improving educational outcomes for learners.

1.4 Research Questions

The main research question asked in this study was:

> *What are the challenges experienced by Grade 7 Mathematics teachers on the integration of digital technology in teaching data handling?*

The following sub-questions were concurrently used to provide the answers to the main question:

- *How do Grade 7 teachers perceive the use of digital technology in teaching data handling?*
- *How do teachers incorporate digital technology in teaching data handling?*
- *How does the integration of digital technology in teaching data handling enhance learning?*

1.5 Aims and objectives of the study

The aim of this study was to explore the challenges that Grade 7 Mathematics teachers face in integrating digital technologies in teaching.

The following objectives were used to reach the aim of the research:

- To explore how teachers perceive the use of digital resources in teaching data handling;
- To investigate how teachers incorporate digital technology for teaching data handling;
- To probe how the integration of digital technology could enhance learning.

1.6 Rationale of the study

Many studies aimed at enhancing the global education system have been conducted over the years. Namibia is one of many nations that have changed and implemented new policies in an

effort to improve and enhance their educational institutions. These modifications and implementations are the result of numerous studies. According to Quadri, Muhammed, Sanober, Qureshi, and Shah (2017), the digital technology revolution has a favourable impact on a variety of daily tasks carried out by humans. In addition to other industries, the education industry has been greatly impacted. According to Ja'ashan (2020) and Quadri, Muhammed, Sanober, Qureshi, and Shah (2017), the traditional learning environment and style are altered by the development of technology like information and multimedia. Lectures can be given by teachers anywhere, at any time. Technology offers a platform for communication between educators and students, altering the dynamic between them in traditional classroom settings. Learners can use the platform to conduct a cooperative study. Time, location, and other restrictions have been eliminated by telecommunication technology, which also offers a great deal of flexibility in teaching and learning activities.

The advantages discussed above can as well benefit mathematics as a subject as well as data handling as a topic. Thus, as the current study sought to study the challenges of incorporating digital technology in teaching data handling in the Grade 7 Mathematics, its recommendations would be use on improving the performance of the topic and the subject at large. The use of technology in teaching Mathematics plays a key role in the accomplishment of desired results and Simataa (2015) assumes that the application of computer technology in teaching and learning will enhance the quality of education in Namibia. The findings, conclusion and recommendations of this study will enlighten the education sector and Mathematics teachers in Namibia about how to incorporate digital technologies in the teaching of data handling.

1.7 Key Terms

Digital technologies are any techniques, systems, equipment, or resources that produce, store,

or process data electronically. Social media, online games, multimedia, computers, and mobile phones are popular examples (Teach with digital technologies, 2019). In this study, digital technologies include the use of a computer and an overhead projector.

Mathematics involves identifying, visualising, and analysing quantitative relationships between Mathematical objects as well as between social and physical occurrences. These procedures lead to the creation of fresh Mathematical concepts and discoveries. Mathematical notations and symbols are used to describe numerical, geometrical, and graphical relationships in their own specialised language (Ministry of Education [MoE], 2015).

Data handling means organising, describing, representing, and analysing numerical information that heavily relies on visual displays like charts, graphs, and plots (Shaughnessy & Greer, 1996). The Grade 7 Mathematics syllabus states that learners must be able to collect, organise, interpret and represent numerical information on various graphs, including pie charts. They must also be able to summarise and report upon the completion of the topic (MoE, 2015).

Circuit is sub-regional division responsible for inspecting a set of schools within the same geographical area in a region. The circuit is also responsible for administering and facilitating communication between schools within that circuit and the Regional Directorate, and promoting information sharing among teachers. Namibia uses regions as its first-level subnational administrative division. Under the Ministry of Education Arts and Culture (MoEAC), the ministry of education has education directorates in each region, under the directorates are circuit offices headed by the inspector of education. The circuit facilitates the communications between schools and the regional directorate of education.

Content knowledge (**CK)** is being familiar with the subject matter that will be taught. Teachers need to be knowledgeable about the subjects they are teaching, including the key terms,

theories, and methods within a particular field, the explanatory frameworks that organise and link ideas, and the norms of evidence and proof (Koehler & Mishra, 2006, 2009, 2012). In the context of this study, teachers must be able to collect and organise data; represent data on various graphs, including pie charts; interpret graphs and data; and summarise and report on data.

Pedagogical knowledge (**PK)** refers to a teacher's in-depth understanding of the procedures, techniques, and approaches used in teaching and learning. It covers a variety of topics, including general educational ideals, values, and purposes. This type of general knowledge applies to lesson design, student assessment, and general classroom management techniques (Koehler & Mishra, 2006, 2009, 2012). In this study, the integration of technologies into teaching is perceived to be the best teaching method of teaching and learning data handling.

Technological knowledge (**TK)** is the understanding, conceiving, and using technology, tools, and resources. This entails having a comprehensive grasp of information technology to use it effectively both at work and in daily life, being able to know when information technology can help or hinder the attainment of a goal and being able to continuously adapt to information technology changes (Koehler & Mishra, 2006, 2009, 2012). Voogt et al. (2013) further define TK as a metric for digital technology ability that enables people to use the tools at their disposal to achieve both personal and professional objectives.

1.8 Research design applied in this study

The research design is a blueprint for the proposed research and may be thought of as the framework for research. It is the glue that holds all the components of a research project together (Akhtar, 2016). McCombes (2021) further explains that a research design is a plan for employing empirical data to address your research issue and ensuring that your methodologies

and data analysis are suitable for your research goals. The collection of data is made easier by a well-planned study design. This study explored the challenges faced by Grade 7 Mathematics teachers to integrate digital technologies in teaching data handling and thus used a qualitative research methodology under a case study design.

The population of the study included Grade 7 Mathematics teachers and Grade 7 learners in Otunganga Circuit. Two teachers and 86 learners from two schools were sampled to take part in the study. The two teachers were then observed while teaching the topic to the 86 learners, 54 from school A and 32 from school B and then were later interviewed. Of the 86 learners who were taught, the researcher selected 30 learners, 15 from each school, to be interviewed to collect more data but only 26 learners were interviewed. Four learners from one of the participating schools withdrew from the study without providing any reasons. Learners who actively took part in the lessons were selected for the interview since the researcher believed they would be able to respond to the questions. Data were analysed through thematic analysis by coding the themes emanating from the data collected. The codes were based on the research question together with the analytical framework themes.

1.9 The scope of the study

While the Namibian government, through the MoEAC, is trying to equip schools with technological tools for the integration of ICT in teaching across the curriculum, there is limited research on the challenges that teachers face. This study thus investigated the challenges faced by teachers in integrating digital technologies for teaching data handling in Mathematics in Grade 7. The study engaged two Grade 7 Mathematics teachers and 30 learners from two rural schools in Otunganga Circuit, in Ohangwena Region, Namibia.

The participants were engaged through observations and interviews as instruments for

collecting data. The study was guided by the TPACK theory and is limited to finding and exploring the challenges that teachers face with the integration of digital technologies into teaching data handling in Grade 7.

1.10 Overview of Chapters

The study consists of five chapters.

Chapter 1 gives the introduction and background of the topic. The chapter also discusses the statement of the problem which is followed by the research questions. Thereafter, the chapter covers the aims and objectives of the study and then the rationale of the study. After the rationale, the chapter defines the key terms, limitations, and the design of the study. The chapter closes with a summary of the chapter.

Chapter 2 gives a review of the literature with discussions of the existing knowledge of earlier studies. This directs the study to find the gap that this study would fill. The chapter also looks at the analytical framework of the study and how it would help to reach the aims of the study.

Chapter 3 highlights the design of the research and the method to be used. The methods will confirm the data and test its reliability. It also provides the approaches that will be used in the study, and the population and sample. Moreover, this chapter discusses the instruments that were used to collect data and how the collected data was analysed. The ethics considerations, validity and reliability of data collection procedures are also discussed under this topic.

Chapter 4 presents the data collected and the analysis of findings. This chapter further uses the findings to answer the main research question and the sub-questions to reach the aim of the research and its objectives.

Chapter 5 presents a discussion and interpretation of the data. The chapter also gives a

discussion of the findings, draws conclusions, viable solutions and recommendations. Finally, the chapter summary brings closure to the study.

1.11 Chapter Summary

Chapter 1 of this study provides a comprehensive overview of the challenges faced by Grade 7 Mathematics teachers in integrating digital technologies into their teaching, specifically focusing on the topic of Data Handling. The chapter begins with an introduction that highlights the necessity of digital technology in education and the specific challenges teachers encounter, influenced by their beliefs and the lack of knowledge about available technologies.

The background section delves into the importance of professional development and access to digital resources for educators, emphasising the struggle many teachers face in utilising technology effectively. It also compares the technological integration in various countries, revealing a disparity between developed and developing nations in terms of access and usage.

The study is anchored in the Technological Pedagogical Content Knowledge (TPACK) theoretical framework, which underscores the interrelatedness of content, pedagogy, and technology in teaching. The purpose of the study is to explore the obstacles that prevent effective integration of digital technologies in Namibian mathematics education.

The chapter outlines the research questions aimed at uncovering the challenges of digital technology integration, the perceptions of teachers regarding its use, and the potential enhancements to learning that such integration could bring.

The aims and objectives section clarifies the intent to investigate teachers' perceptions, the methods of digital technology incorporation, and how this integration could improve learning outcomes. The rationale for the study is to contribute to the enhancement of the global

education system, with a focus on Namibia's efforts to improve educational institutions through technology integration. The chapter defines key terms relevant to the study, such as digital technologies, Mathematics, Data Handling, and various educational concepts. The research design section describes the qualitative methodology and case study approach used to collect data from teachers and learners in two rural schools in Namibia.

Finally, the chapter concludes with an overview of the subsequent chapters, setting the stage for a detailed exploration of the literature, research methods, findings, and recommendations that will follow.

Chapter 2
Theoretical framework and literature review

2.1. Introduction

This chapter presents the study's theoretical framework and the literature reviewed on the use of digital resources. The TPACK theoretical framework literature was reviewed to investigate teachers' required level of TPACK knowledge in teaching Mathematics; the impact of TPACK on learning Mathematics; challenges faced by teachers in incorporating digital resources in teaching data handling; methods of teaching and digital resources on learner-centred teaching and learning enhancement. This study highlights that TPACK underpins the teaching of data handling for effective pedagogy in a 21st century classroom.

2.2 Theoretical Framework

In addressing the challenges faced by Grade 7 mathematics teachers in integrating digital technologies for teaching data handling, the Technological Pedagogical Content Knowledge (TPACK) framework serves as a pivotal theoretical lens. Developed by Mishra and Koehler, TPACK elucidates the complex interplay between three primary forms of knowledge: content (CK), pedagogy (PK), and technology (TK) (Kurt, 2019; Koehler & Mishra, 2012).

Content Knowledge (CK): At the core of effective teaching lies a deep understanding of the subject matter. For Grade 7 mathematics, this encompasses a robust grasp of data handling concepts. Pedagogical Knowledge (PK): This dimension involves the methodologies employed to impart CK to students. It includes strategies that facilitate learning and comprehension of data handling in a classroom setting. Technological Knowledge (TK): TK pertains to the digital tools and resources that can enhance the teaching and learning experience. In the context of data handling, these technologies might include data visualization software or interactive

statistical platforms.

The TPACK framework posits that the most effective teaching arises from the intersection of these knowledge domains, creating a holistic approach to curriculum design and instruction. For Grade 7 mathematics teachers, the integration of digital technologies presents both opportunities and challenges. While these tools can make abstract data handling concepts tangible and interactive, teachers must navigate barriers such as access to resources, institutional support, and their own attitudes towards technology integration (Bećirović, 2023).

By leveraging the TPACK framework, this dissertation will explore the nuanced barriers that Grade 7 mathematics teachers face, such as aligning technological tools with pedagogical goals and content requirements. It will also examine strategies for overcoming these obstacles, thereby enabling teachers to effectively integrate digital technologies into their data handling instruction.

Studies show that the teacher should enable the learners to understand that the use of digital technology can facilitate active learning experiences and inclusion (Akturk & Ozturk, 2019; Skaik & Tumpa, 2022). Akturk and Ozturk (2019) further argue that teachers' elevated levels of TPACK support learners' academic achievements while successfully integrating digital technologies in teaching. For effective technology integration into teaching, Akturk and Ozturk (2019) and Bingimlas (2018) recommend that more studies be based on in-service teachers' TPACK levels and teachers' training on technological usage for effective technology integration in teaching (Kim, 2018). Koehler and Mishra (2006) developed the technological pedagogical content knowledge (originally TPCK) framework, which is now known as the technology, pedagogy, and content knowledge (TPACK) framework, to understand the knowledge teachers need to incorporate technology into their teaching. They built the theory

on Shulman's (1986 cited in Koehler & Mishra, 2006) construct of pedagogical content knowledge (PCK). The literature, based on the impact of the integration of digital technology and the TPACK model in teaching, shows that there is more potential for academic achievement when technology is used for teaching and learning.

2.2.1 TPACK and teacher integration of technology in teaching

Literature shows that academic achievements are highly influenced by the integration of technology with teaching and learning. Leach et al. (2005) argue that technology promotes learner-centred pedagogy, while Omoso and Odindo (2020) suggest that technology can potentially revolutionise teaching and learning if skilfully integrated with teaching. Relating to the earlier studies on technology integration, the arguments clearly show that technology in schools flourishes when it is practised together with pedagogy and content. The constructivist theory of learning ought to be a suitable form of pedagogy that teachers can make use of to teach the data handling content. Therefore, for the components of knowledge to be interrelatedly used Koehler and Mishra (2006) built on Shulman's 1986 PCK model to develop the TPACK model which enables teachers to get and use the proper technological tools in preparation and delivery of the subject content. The three components of knowledge that make up the TPACK theory are: Technological, Pedagogical, and Content Knowledge.

The TPACK framework is conceptualised in terms of seven knowledge domains, namely, (1) content knowledge (CK), which is knowledge about the actual subject matter that is intended to be taught; (2) pedagogical knowledge (PK), which is knowledge about the processes and practices or strategies about teaching; (3) technological knowledge (TK) that constitutes knowledge about operating digital technologies to teach; (4) pedagogical content knowledge (PCK), the interaction of PK and CK; (5) technological content knowledge (TCK), the

interaction of TK and CK; (6) technological pedagogical knowledge (TPK), the interaction of TK and PK; and (7) technological pedagogical content knowledge (TPACK), the interaction of PCK, TCK, and TPK (Koehler & Mishra, 2006). In line with this study, the TPK refers to pedagogically sound ways of using technology concerning teaching data handling in Grade 7 Mathematics. Figure 2.2 below, shows how the three components are combined, how they communicate and how they can be effectively incorporated with teaching:

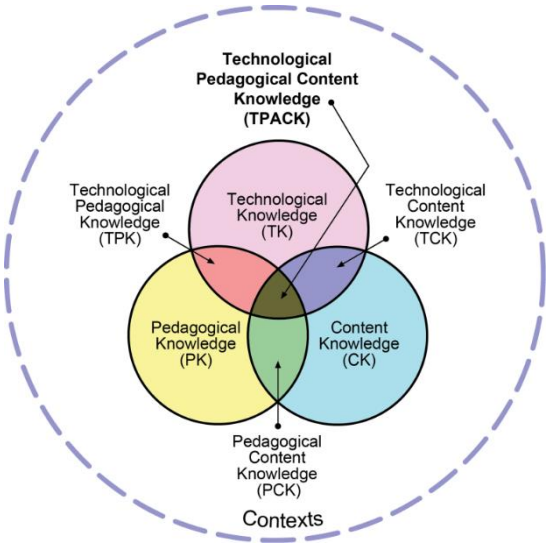


Figure 2.2: The TPACK framework and its knowledge components
(Source: Koehler & Mishra, 2012)

While focusing on the intersection of the three components of technology, content, and pedagogy, Lee and Hollerbrands (2008), Niess (2005) and Achary (2011) highlight four critical aspects that make up the teachers' TPACK: (1) a broad vision of what it means to teach a subject while incorporating technology to the learning process; (2) knowledge of instructional methods and representations for using technology to teach specific topics; (3) learners' awareness, reasoning, and learning through technology are all protected; and (4) knowledge of technology-enhanced learning curricula and curricula content.

In light of the above, Science and Mathematics teacher training should focus on directing the growth of learners' skills and thought in a way that considers the development of an overall vision of teaching with technology (Niess, 2005). A number of studies support Niess' (2005) supposition. For example, Bingimlas (2018) examined the extent of teachers' knowledge of this theory in Saudi Arabia, concluding that most teachers' knowledge of the theory's components is average, and recommended that teachers abandon conventional teaching methods in favour of technology for better teaching and learning. Furthermore, the MoE should provide teachers with proper technical training. In Lesotho, Lisene and Jita (2018) used the TPACK model to investigate the knowledge base of Physical Science teachers in terms of incorporating ICTs. Teachers' incorporation of ICTs is below average, according to the report, and more support for teachers is needed to maximise the use of ICTs in lesson delivery. In Taiwan, Hsu and Chen (2019) investigated teachers' success by using technology-enhanced teaching methods. Their research suggests that teachers should have sufficient technical skills to supply useful material and learning opportunities to students.

Furthermore, various studies show that the TPACK theory is used in lesson delivery in all sectors of education around the world. Yet, there are barriers to its successful integration, such as a lack of resources, a lack of support, attitudes toward technology (Lisene & Jita, 2018; De Freitas & Spangenberg, 2019), and teachers' limited technology knowledge (Lisene & Jita, 2018). Inappropriate and inadequate technical teacher growth in improving their TPACK, according to De Freitas and Spangenberg (2019), often leaves learners at the mercy of being entirely taught in conventional ways and therefore calls for continuous professional development (CPD). Niess et al. (2019) highlight that the research may have important consequences for in-service teacher support, including professional development and pre-service teacher training services, in the chapter of their book on teachers' skills, values, and

attitudes about Mathematics teaching as they relate to TPACK. This may be related to De Freitas and Spangenberg's call for CPD. Among the measures introduced by Niess et al. (2019:49), are steps to: 1) incorporate Mathematics instruction with proper technology; and 2) assess their use of technology and its effectiveness in Mathematics instruction. They suggest that Mathematics teachers should stop thinking about technology in isolation from their PCK.

Another study by Leendertz et al. (2013) investigated Mathematics teachers' TPACK levels and how they relate to the successful teaching of Grade 8 Mathematics in South Africa. The findings show that teachers' TPACK in Mathematics helps them teach more effectively. They also, however, recognised the obstacles to the ICT integration of Mathematics teachers and advocate for ongoing professional development for teachers. According to a study conducted in Lesotho by Bohloko et al. (2019), incorporating YouTube videos (as part of technology) with teaching Chemistry, resulted in improved learner efficiency, and thus they recommend that teacher training incorporates technology. Koehler and Mishra (2006) argue that teachers will need to learn more than just how to use currently available tools; as existing technology becomes outdated, they will also need to learn new strategies and skills.

Even though the technology is seen as an important part of the classroom, teachers also have difficulty incorporating it with their lessons. Erdogan and Sahin (2010) note how teachers have difficulty with technology, pedagogy, and material awareness. Understanding the three key components (technology, pedagogy, and content knowledge) and their relationship is critical when delivering successful technology-based instruction. The TPACK is made up of these three information constructions. This research investigated the three key components in teaching data handling. According to Hoepfl (1997), research problems are often framed as open-ended questions that will aid in the exploration of new knowledge. The TPACK theory’s three components (technology, pedagogy, and content knowledge), when properly

incorporated, will result in successful teaching and learning.

This study assumes that the TPACK theory aligns with the constructivist world view in teaching. The constructivist view of learning sees learners as constructors of their own knowledge and teachers as facilitators of how learners construct their knowledge. Thus, teachers can prepare technology-based lessons and strategise on the theory of constructivism to present the lessons. The constructivist theory serves as the pedagogical method to facilitate the teaching and learning process.

2.2.2 Interrelating TPACK and data handling

This study views computer-assisted teaching as essential in delivering the content of data handling. Teachers are challenged to maximally incorporate their computer skills with their teaching techniques and the data handling they know. For example, in their classrooms, learning could be made interesting by allowing learners to present data on graphs utilising a computer or they could simply draw graphs and retrieve them for learner reference. Therefore, in this study, TPACK underpins the classroom practice for effective teaching and meaningful learning of data handling. Figure 2.3 shows the interrelation of technology usage, pedagogical skills, and teachers' content knowledge in teaching data handling.

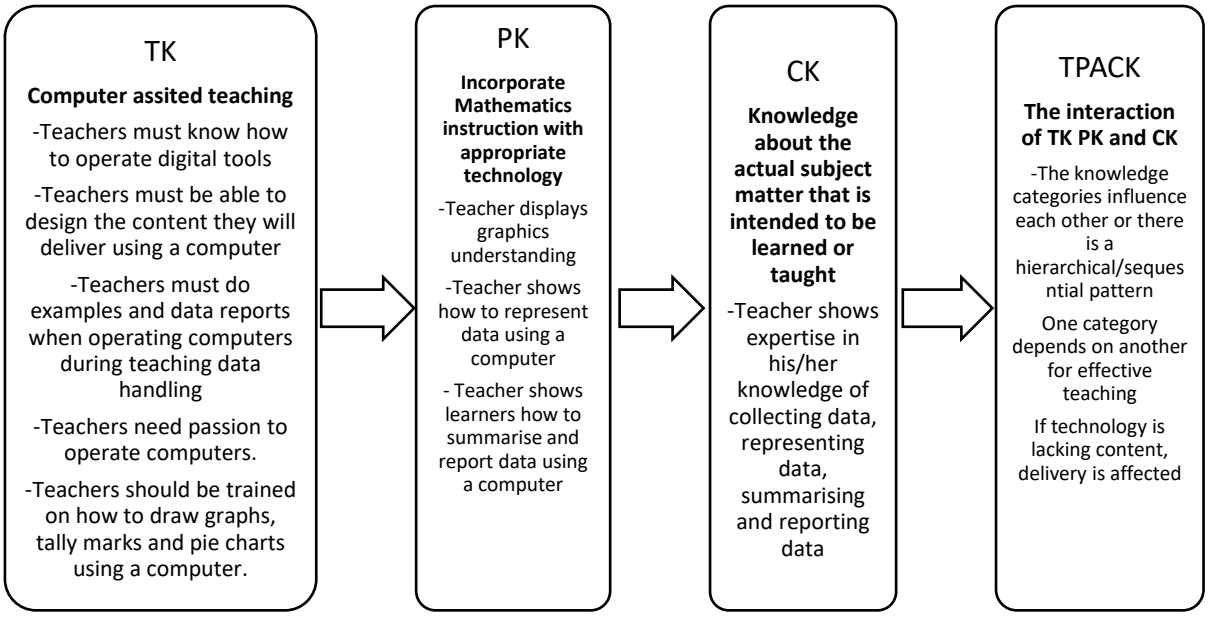


Figure 2.3: Interrelating technology, pedagogical experiences, and content knowledge. Source: Adapted from Achary (2011), Koehler and Mishra (2012), Lee and Hollerbrands (2008), and Niess (2005).

In Figure 2.3, the interrelation of technology, pedagogy and content is viewed to be a complete body of knowledge that could enhance teaching and learning of data handling. It shows how a teacher should be equipped with all three types of knowledge and the emergence of the TPACK for successful integration of technology with teaching. Pannen (2014) shows that there are several benefits in ICT usage, when used properly. Thus, the figure illustrates the role of technology inclusion in teaching and how it could lead to effective teaching and learning. Bingimlas (2018) further explains that all the domains of TPACK are complicated and interconnected, and so, it proves difficult to separate each domain.

The importance of TPACK in the teaching and learning process has been proven in studies. There are plans for CPD (De Freitas & Spangenberg, 2019) funding for teachers to maximise the use of ICTs in the classroom (Lisene & Jita, 2018), and a move away from seeing

technology as separate from teachers' PCK (Niess et al., 2019). While technology presents challenges for teachers, it also supplies powerful resources for supporting their work and, when used appropriately, it can improve students' skills (Achary, 2011). It is widely accepted that data handling is one of the most poorly performed topics in Grades 5 to 7 (Nambira et al., 2009). Even though Namibia's education system recognises the importance of technology (MoE, 2005), there has been little emphasis on the integration of technology in Mathematics and its topics. The Namibian education system, on the other hand, has made use of the CPD Journal for Education in Namibia which is done by the University of Namibia (UNAM), and helps educators to recognise existing problems in teaching and learning in Namibian classrooms, among other things (CPD Unit, 2014). As a result of this review, CPD for TPACK must become a part of in-service teacher training programmes and developing a deeper understanding of the TPACK model in pre-service teacher training programmes will successfully integrate technology with teaching data handling.

2.3 Teachers' perspectives on the use of digital resources to teach data handling

The perspectives of Grade 7 Mathematics teachers on the use of digital resources in teaching data handling are multifaceted. Research indicates that teachers recognize the importance of integrating digital technology to enhance the teaching and learning process (Merillo & Domingo, 2019). They often use digital technologies to facilitate various aspects of mathematics education, including data handling.

Teachers' choices in digital technology use are influenced by their technological, pedagogical, and content knowledge (TPACK). The degree of integration of digital technology in the classroom seems to be connected to their TPACK developmental stage (Loong & Herbert, 2018). Teachers with a more developed TPACK are likely to use digital resources more

effectively in their teaching practices.

Moreover, studies suggest that while there is evidence for the benefit of using digital technologies for mathematics learning, issues of equity with respect to access to and use of digital technologies are important but under-researched (Drijvers & Sinclair, 2023). Teachers also face complexities in integrating digital technology, which includes fitting ICT into existing pedagogies and the need for a sharper focus on the pedagogy of ICT (Loong & Herbert, 2018).

While Grade 7 Mathematics teachers generally view the use of digital resources positively, their effective integration into data handling lessons varies and is dependent on several factors, including the teachers' TPACK development and the pedagogical approaches adopted.

2.3 The impact of TPACK on learning

The TPACK framework is a model that helps teachers integrate technology into their teaching in an effective way. It emphasizes the connection between three types of knowledge: Content Knowledge (CK): What teachers know about the subject they teach. Pedagogical Knowledge (PK): The methods and processes of teaching. Technological Knowledge (TK): Knowledge about the digital tools and resources available for teaching (Koehler & Mishra, 2012).

The TPACK framework suggests that effective teaching with technology requires an understanding of how these three types of knowledge interact. Teachers need to know not just the subject matter (CK) and how to teach it (PK), but also how to use technology to support learning (TK). This intersection of knowledge types can enhance students' learning experiences when technology is used (Kurt, 2019; Koehler & Mishra, 2012).

The impact of TPACK on teachers' ability to teach with technology is significant. It can influence their self-efficacy and attitude towards using technology, which in turn affects their

willingness and ability to integrate it into their teaching practices (Bai, Guo, & Gu, 2023). When teachers feel confident in their TPACK, they are more likely to use technology in ways that can improve student learning outcomes.

Regarding the challenges faced by grade 7 mathematics teachers in integrating digital technologies for data handling, TPACK plays a crucial role. Teachers need to have a good grasp of TPACK to overcome common obstacles such as: Selecting appropriate digital tools that align with the mathematics content. Designing pedagogical strategies that effectively use these tools to teach data handling concepts. Addressing the lack of resources, support, and professional development opportunities related to technology use in education (Bećirović, 2023; Muhazir & Retnawati, 2020; (Parajuli & Koirala, 2021).

While investigating the effects of programming education planned with TPACK, Atun and Usta (2019) found that academic achievement in the group under study was significantly higher and concluded that TPACK framework presentations have a positive impact on learning outcomes. After examining the effectiveness of the TPACK framework on Mathematics mobile learning, Hernawati (2019) also concludes that the model improves learners' performance and achievement in Mathematics, increases learners learning motivation and changes the attitudes of learners towards the subject. The model has an influence on learners' performance if it is appropriately included in the teaching and learning process. Learning takes place effectively when the best technological tool is used with the proper content delivery method.

Mukhari (2016) reports that the integration of technologies in teaching develops learners' high thinking capacity levels to be able to solve problems, which is a requirement of employers of the 21st century. Mukhari (2016) and Cavas et al. (2009) further report that learners make use of the technologies such as computers, mobile phones and the internet to access information

related to their schoolwork, even in the absence of the teacher, to interact with fellow learners and to achieve their own learning needs. Kafyulilo and Keengwe (2013) report that the Tanzanian educational authorities, as well as the government, are concerned about learners' performance in Mathematics and Science subjects, while Shin et al. (2012) regard the integration of ICT in these subjects as the solution to improve learners' performance. Mukhari (2016) suggests that the role of the teacher is to provide guidance that allows learners to engage in active learning strategies for better understanding and performance.

In summary, TPACK helps teachers navigate the complexities of integrating technology into their teaching, which is especially important for subjects like mathematics where data handling can be enhanced through digital tools. By developing their TPACK, teachers can better face the challenges of using technology to support their teaching and improve their students' learning experiences.

2.4 Teachers' perspectives on the use of digital tools in teaching and learning

Teachers' perspectives on the use of digital tools in teaching and learning data handling in mathematics are multifaceted. They recognize the potential of digital technologies to enhance student engagement and understanding of mathematical concepts. However, they also face challenges such as ensuring equitable access to technology, aligning digital tools with curriculum goals, and acquiring the necessary skills to integrate these tools effectively into their teaching practice (Loong & Herbert, 2018; Drijvers & Sinclair, 2023).

Research indicates that teachers see digital tools as a means to engage students through interactive and dynamic tools can make data handling more engaging for students. Digital tools also facilitate understanding as visual representations and simulations can help students grasp complex data handling concepts. Moreover, digital tools help to differentiate instruction where

technology can provide opportunities for personalised learning experiences (Hoyles, 2018).

However, teachers also express concerns about training and support, resources and pedagogical fitness. Teachers express that there is often a need for more professional development to help teachers feel confident using digital tools. Access to and availability of digital tools can be limited, affecting their integration into the classroom. Teachers must also consider how digital tools align with their teaching methods and the content being taught (Ansayam & Tan, 2021).

Overall, Loong and Herbert (2018); Drijvers and Sinclair (2023) emphasise that while teachers acknowledge the benefits of digital tools, they also emphasize the importance of thoughtful integration that supports pedagogical objectives and addresses the challenges associated with technology use in education.

2.5 Teachers' challenges in incorporating digital resources in teaching

According to Mathevula and Uwizeyimana (2014), educators meet a range of challenges when it comes to using digital technology, including a lack of equipment, insufficient teaching on ICT integration, and a lack of trust in teachers. Therefore, they conducted an investigation and asked the question: if ICT can lead to the development of teaching and learning and have socioeconomic and pedagogic benefits, why has ICT integration in schools been slow? Ramorola (2013) also highlighted the difficulties that teachers and students face in successfully incorporating technology in teaching and learning. The difficulties Ramorola (2013) found were: the unavailability of a technology policy, insufficient technology equipment, a lack of teachers qualified in technology integration, and maintenance and technical problems.

Naidoo and Mkhabela (2017) explored South African teachers' skills in teaching data handling, while a study done in Malaysia was conducted to identify student learning problems in data handling (Julius et al., 2018). Moila (2006); Naidoo and Mkhabela (2017); Julius et al. (2018)

recommend that teachers should get adequate training in educational technologies for better integration in teaching and learning, and schools should be equipped with ICT infrastructure. While Nambira et al. (2009) conclude that data handling is one of the poorly performed topics in Grade 7, the literature on Grade 7 Mathematics topics is not focused on the integration of digital technologies in teaching topics, including the data handling topic. Therefore, this study was conducted to learn more about the difficulties that Grade 7 Mathematics teachers face while incorporating technology in their classrooms.

2.6 Data handling content area in Grade 7 Mathematics

In Grade 7, the topic data handling in the mathematics syllabus includes two learning objectives, under which seven basic competencies are to be achieved. Under this topic, learners should be able to gather and organise data, represent data on a variety of graphs, including pie charts, interpret graphs and data, and summarise and report on their findings (MoEAC, 2015). The syllabus further requires learners to know how to design and use data collection instruments and data recording and representation strategies, under which they design and use yes/no and/or multiple-choice response questionnaires to collect data; organise and record responses from questionnaires on tables and tally charts; and represent data on several types of bar graphs, broken line graphs, pictograms, and pie charts. Learners should also know how to extract, analyse, and interpret data from tables, bar graphs, pictograms, and broken line graphs; extract and interpret data represented in pie charts and convert to data; find the mode, median and calculate the average (mean) of a set of discrete data; and draw conclusions and/or make predictions (MoEAC, 2015).

Although the learning objectives and competencies of the syllabus are well aligned and challenge learners to objectively deal with real-life scenarios, Nambira et al. (2009) report to

NIED that learners still struggle to master them and underperform on the topic. The topic is important in Mathematics education because it involves real-life scenarios and aids in the development of critical thinking skills in students; however, international tests show that students are not performing well in this topic (Naidoo & Mkhabela, 2017). The context, information, experience, and products are the main outcomes of educational activity. These students engage in activities such as data collection, processing, storage, and presentation. These operations increasingly entail cooperation and communication between them. Therefore, compared to their peers, children who are exposed to technology on a regular basis in the classroom have superior "knowledge", presenting skills, innovative capabilities, and are willing to put more effort into their studies (Shyti et al., 2023). While investigating the impact of computer-assisted teaching on the quality of data handling learning in Grade 7, Achary (2011) suggests that it is critical to emphasise graph understanding in the teaching of data handling. Achary (2011) presents reasons why computer intervention is essential in the teaching of data handling: it helps learners in technological advancements; it enhances drawing skills; it creates a lasting interest in learners; and it provides new knowledge.

2.7 Technological tools used in teaching data handling

As a developing country, Namibia is one of the countries that still rely on computers/laptops as a form of technology available in Namibian schools. Lately, computers and overhead projectors have been introduced to a few schools in the country, mostly in urban areas and a few in rural areas. Nendongo (2018) reports that out of 94 schools in the Ohangwena Region that took part in her study, only 24 were equipped with computer laboratories, yet only 34% of the 24 schools were functional and had internet access. This is because most of the rural schools in the country still do not have internet network coverage, the infrastructure to accommodate modern technologies, such as computers and overhead projectors, and electricity. The digital

tools discussed as appropriate for integration in teaching data handling are, a computer, computer software, PowerPoint and a projector. Thus, this study focused on teachers' use of computers, software and projectors during the teaching and learning process. Computers are used to prepare PowerPoint presentations, which are then presented through projectors.

2.7.1 Computer as a digital tool to teach data handling

Because they can be used for so many beneficial purposes, computers are one of the most important classroom resources. According to Barroso (2019) the use of educational software and programmes is one of the most widespread uses of computers in education today as they increase student engagement. Teachers can now use technology in their lessons to deliver instruction in a variety of ways and cater to a variety of learning styles. Technology assists teachers in making the subject matter easier for students to understand. Examples include using computers to create presentations on a topic or showing video clips that complement the current lesson (Barroso, 2019).

2.7.2 Computer software, PowerPoint, as a digital tool to teach data handling

PowerPoint is a software product that is used in education as a teaching and information delivery medium in classrooms (Rofi'I & Nurhidayat, 2020; Hashemi et al., 2012). Although it was primarily created for presentations rather than for in-class teaching and learning, Hashemi et al. (2012) reports that its implementation in educational contexts provides pupils with improved ways of receiving knowledge. PowerPoint provides graphics and other multimedia to clarify concepts and accommodate various learning styles (Hashemi et al., 2012; Rofi'I & Nurhidayat, 2020). Rofi'I and Nurhidayat (2020) emphasise that, with the use of PowerPoint, learners can share engaging presentations on a low-cost desktop computer by combining text, video, animation, audio, graphics, and test resources.

PowerPoint is a contemporary teaching tool that allows educators to deliver their lessons and lectures in contemporary ways using graphics, charts, and diagrams together with audio and video accompaniment. Additionally, it enables teachers to complete lengthy lesson plans quickly (Guerid, 2020). However, Guerid (2020) also contends that excessive use of PowerPoint can result in bad teaching in circumstances where there is little or no human connection and where students are passive observers and listeners. This has a detrimental impact on their enthusiasm and motivation.

Although PowerPoint is used in teaching, there is still limited scope for its use in teaching data handling, as a topic.

2.7.3 A projector as a digital tool to teach data handling

An effective substitute for chalk and discussion is the overhead projector (OHP), a common teaching strategy. By creating the materials in advance, the OHP provides high-quality education. OHPs let teachers use pictures and diagrams while reducing their workload by not drawing it on the board. The more complex sources from OHP can be used in any classroom because they are simple to use, adaptable, and allow students to take notes (Alkamel & Chouthaiwale, 2018). Fetsi (2023) explains how the OHP, when combined with a traditional blackboard, can accommodate the needs of various learner types, encourages interaction and communication in educational environments while also saving time. Fetsi (2023) uses the overhead projector to display the lesson and adds explanations on the blackboard. There is limited scope on the use of OHPs to teach data handling as a topic. Nonetheless, the benefits of OHPs, discussed above, provide an advantage when the tool is utilised to teach the topic.

2.8 The effect of digital resources on learner-centred teaching and learning enhancement

This study argues that digital resources can enhance teaching and learning when effectively

and efficiently utilised. Ali and Kassim (2007) maintain that many new methods of teaching and learning incorporating technology have evolved and are continuously being developed in the field of education. Since ICT is learner-centric, it encourages students to actively take part in the learning process. When learning activities are engaging, real, multisensory, and cross-disciplinary, students become more motivated (Elets Digital Learning, 2020). ICT initiatives and programmes have been shown to increase student motivation, attendance, academic success, and effective communication in schools (Elets Digital Learning, 2020). The benefits of ICT programmes extend to teachers as well. They find that ICT is helpful for both personal and professional tasks, as well as for teaching. ICT integration in the classroom improves learning by making it more creative, engaging, interactive, simple, and efficient. It enhances the traditional methods of teaching and learning (Elets Digital Learning, 2020). In what they refer to as a Student-Centred Learning (SCL) approach, Ali and Kassim (2007) highlight that, in SCL, a teacher who serves as a facilitator can encourage negotiation and engagement between students and teachers, whether in person or through ICT. Mutilifa (2017) believes that the effectiveness of learner-centred teaching and learning enhances learners' performance.

Several studies have identified a number of key effects of digital resources on learner-centred teaching and learning and how they can enhance learning. Digital resources have a profound impact on learner-centred teaching and learning enhancement. They offer diverse and interactive content, enabling personalised learning experiences that cater to individual student needs and learning styles. The key effects are such as accessibility, adaptability and teacher support (Tammets, Sarmiento-Márquez, Khulbe, Laanpere, & Ley 2022), engagement and skill development (Timotheou, Miliou, Dimitriadis, Sobrino, Giannoutsou, Cachia, Martínez-Monés, & Ioannou, 2022), collaboration (Samaranayake, 2020) and performance (Alenezi, 2020). These effects are discussed below.

Through accessibility, digital resources provide learners with easy access to a wealth of information and educational tools, often available anytime and anywhere, which can facilitate continuous learning outside the traditional classroom setting (Tammets et al., 2022). Accordingly, Tammets et al. (2022) discuss that digital resources can also be updated and adapted quickly to include the latest information, unlike traditional textbooks. This ensures that learners are accessing the most current and relevant content. In the same vein, resources can assist teachers in creating a more learner-centred environment by providing them with a variety of teaching tools and resources to differentiate instruction and meet the diverse needs of their students.

Engagement is another effect that Timotheou et al. (2022) discuss that interactive elements such as videos, quizzes, and simulations can increase student engagement and motivation, making learning more appealing and enjoyable Additionally, the use of digital tools can help students develop essential 21st-century skills, including digital literacy, critical thinking, and problem-solving abilities. Technology also enables collaborative learning environments where students can work together on projects, share ideas, and provide feedback to one another, fostering a sense of community and teamwork (Samaranayake, 2020). Lastly, Alenezi (2020) suggest that the appropriate use of e-learning materials and tools within an educational context can lead to higher student performance and more efficient teaching practices.

However, it's important to note that the effectiveness of digital resources in enhancing learning largely depends on how they are integrated into the teaching and learning process. Merely having access to technology does not automatically translate to improved learning outcomes. It requires thoughtful implementation, adequate teacher training, and alignment with pedagogical goals to truly enhance learner-centred education (Tammets et al. 2022; Wang, Chen, Teng, Liu, & Jing, 2024).

2.9 Constructivist perspective in teaching data handling

Teaching and learning processes are said to be constructivist when people are active in creating their own ideas, perspectives, and viewpoints. Learners can put the constructivism theory into practice when they bring their experiences, ideas, and perspectives into the learning environment in order to understand the concepts taught. Humans generate knowledge about the world via their interactions with it (Kapur, 2019; Shah, 2019). The teacher's job in a constructivist classroom goes beyond only giving lectures and passing along knowledge and information about academic subjects to the students. Teachers effectively carry out their job responsibilities and behave as professionals by assisting learners in acquiring cognitive strategies like self-assessment, articulation, understanding, questioning, and reflection. In constructivist classrooms, teachers' main responsibility is to arrange information around “big ideas” that will inspire learners to learn. Teachers also help pupils to relate their new ideas to what they have already learned. Students are encouraged to ask questions as the activities are learner centred. Conclusions are drawn from their own experiments and analogies (Bhattacharjee, 2015; Kapur, 2019). By putting learners at the centre of teaching and learning, learners will be able to exercise real life situations as contextualised in data handling. Thus, teachers can help learners to deal with the collection, organising, interpretation and presentation of data, and other competencies instead of the teacher showing learners and lecturing how all that is done.

Constructivism in education is a theory that posits learners construct knowledge through their experiences rather than just passively receiving information. When it comes to teaching data handling with digital tools, constructivism plays a significant role in shaping how these tools are used to facilitate learning.

Constructivism promotes active learning. It encourages active participation from learners.

Digital tools for data handling allow students to manipulate data, visualise results, and draw conclusions actively, thus constructing their understanding of data concepts. It also promotes personalised learning paths. Digital tools can offer personalised experiences where learners can progress through data handling tasks at their own pace, reflecting the constructivist idea that learning is a personal journey for each student. Many digital tools support collaboration, allowing students to work together on data handling projects. This aligns with the constructivist view that social interaction is key to building knowledge (Naidoo & Mkhabela, 2017). According to Zagade (2017) constructivism emphasises problem-solving as a way to learn. Digital tools provide real-world data handling scenarios where students can apply their knowledge to solve problems, thereby constructing new knowledge based on prior experiences. Constructivist learning involves reflection on experiences. Digital tools often have features that allow students to track their progress and reflect on their learning process, which is crucial for deepening their understanding of data handling. Zagade (2017) further discuss that constructivism advocates for learning in context. Digital tools can simulate real-life data handling situations, making learning more relevant and meaningful for students.

In essence, constructivism and digital tools complement each other in teaching data handling by providing an environment where learners are actively engaged, can collaborate, solve problems, reflect on their learning, and experience authentic and personalized learning scenarios.

2.12 Chapter summary

This chapter examines the theoretical framework and literature review considering the research conducted for this project. It covers the theoretical context, data handling as a subject, and the challenges of incorporating digital technology to Mathematics instruction. The TPACK

framework plays an essential role to unpack the challenges of teachers. Teachers integrated and specialised knowledge is needed for effective technology integration with instruction. Studies showed that teachers' elevated level of TPACK improves learners' academic achievements. Teachers with high TPACK will be able to effectively use technology. The TPACK model makes significant changes in the way education takes place across all phases of the education system. Based on the literature, learning takes place when the best technological tool is used with the proper method to deliver the content. Studies conducted on the challenges that teachers face with the integration of digital technologies also found a lack of equipment, insufficient teaching on ICT integration, and a lack of trust in teachers as some of the challenges that teachers face.

Furthermore, the chapter investigated data handling as a topic which shows the competencies Grade 7 learners should achieve under the topic. The interrelation of the three components of the TPACK model was also reviewed and findings show that the domains are complicated and interconnected, making it difficult to separate each domain in its class or sub-class. The theoretical perspectives also show the development of the theory and how it has been applied to various aspects of literature. Overall, a link between the current study and theoretical perspectives, and earlier studies, have been proven in this chapter.

Chapter 3
Research Design

3.1 Introduction

In this study, research design is considered as the framework for research that ties all the different parts of this study together. Akhtar (2016) and McCombes (2021) agree that a research design is a plan for using empirical data to address a research issue. Cohen et al. (2018) define a research design as a strategy or method that is designed to structure research, making it work so that research questions can be answered based on facts and evidence. USC Libraries (2023) comments that a research design is the technique used to coordinate the various parts of the investigation reasonably and coherently to adequately address the exploration issue; it sets up the plan for the assortment, estimation, and examination of information. Maxwell (2012) further argues that research designs allow researchers to answer research questions critically, accurately, and as economically as possible. This study advanced the exploration of challenges faced by Grade 7 teachers to integrate digital resources to teach data handling from the interpretivist perspective.

3.2 The interpretivist world view

According to interpretivism, people's experiences and perceptions shape their interpretation of reality, making truth and knowledge subjective as well as historically and culturally placed (Ryan, 2018). The phenomenological method is used by interpretivists, who try to make sense of the world by interpreting and describing other people's experiences. It is heavily influenced by philosophical principles (Ryan, 2018; Alharahsheh & Pius, 2020). Teachers and learners were subjectively allowed to express their own perceptions and experiences, that this study would then interpret, analyse and discuss. Constructivist epistemology is related to

interpretivism. According to this viewpoint, people cannot access the real world in their thinking, and their understanding of the observed reality must be carefully understood by the careful application of interpretivist techniques (Nel, 2019).

Since the main objective of this study was to understand the difficulties faced by Grade 7 Mathematics teachers in integrating digital technology in teaching data handling, the interpretive approach is appropriate. In order to identify the challenges, a qualitative methodology was used because interpretivism places a strong emphasis on qualitative analysis (Alharahsheh & Pius, 2020). Data collection and validation were done by speaking with teachers and learners.

3.3 Research methodology

Research methodology is the broad phrase used to describe the study, methods, approaches, and processes employed in an investigation to learn something. It includes, for instance, sampling techniques, the tools employed in data collection, the collection of data as well as the participants, and data analysis (Kivunja & Kuyini, 2017). Rehman and Alharthi (2016) further explain that the method helps the researcher to determine the kind of data needed for a study and the most suitable data-gathering methods for that study's aims.

In the current study, a qualitative research methodology was used for the collection, examination and translation of visual data to gain insights into a specific phenomenon of interest. Multiple assumptions, structured for assorted reasons, are made under qualitative methods (Gay et al., 2012). Hypotheses are usually avoided in qualitative research before the data are obtained as their questions and approaches begin to grow as the understanding of the research context and the participants extends. Qualitative researchers will nevertheless have an idea of what they want to explore when they reach the research area.

Following a qualitative research methodology, a researcher observes, conducts interviews, summarises, explains, analyses, and interprets occurrences in their truest form (Basias & Pollalis, 2018). In this study, qualitative data were collected from teachers and learners, sampled with a homogenous sampling technique, through observations and interviews. A case study was used as an approach and data were analysed through thematic analysis. The next section discusses the case study as a research approach to this study.

3.4 Research approach

Creswell (2014) portrays study approaches as investigative plans and approaches that shift from common presumptions to the comprehensive information collection, examination, and translation of strategies. Creswell (2014) further states that the proposal holds a variety of decisions that must be made to be effective. The ultimate decision involves which method should be used to research the subject. The philosophical ideas that the researcher brings to the study should inform this decision; the investigation technique (called test designs); and the basic research methods for information collection, investigation, and translation. The selection of the research method should also be focused on the essence of the research problem or issue being discussed, the researcher's knowledge and the study audience.

In this study, I used the single case study qualitative research approach. Creswell (2014) characterises a case study as an approach for investigating and understanding the meaning people or groups attribute to a common or human problem. Creswell (2014) further explains that the study process includes emerging problems and techniques, the data usually collected in the setting of the partaker, the inductive interpretation of data from data to general themes, and the researcher interpreting the significance of the information. Gay et al. (2012) further explains that solitary case studies concentrate on investigating phenomena that arise within a

bounded structure. This method enabled the researcher to concentrate only on Grade 7 Mathematics teachers and learners taking part in the study.

3.5 Research Design

In this study, a case study was found to be a suitable research design to answer the research questions. Gay et al. (2012) describes case study analysis as a qualitative research method in which researchers concentrate on a unit of study, known as a boundary structure. As a result, under this design, the researcher would be able to classify the target group to carry out the study and collect the data that are useful for answering research questions. Under the qualitative case study research approach, the study was able to study the challenges that teachers face in integrating digital technologies in teaching data handling; the impact of digital technologies in teaching; the teachers' perceptions of incorporating digital technologies in teaching data handling; and how digital technologies could enhance learning through interviews and observations to the Grade 7 Mathematics teachers and a test conducted with learners. The case under study was two schools from the Otunganga Circuit in the Ohangwena Region of Namibia.

3.6 Population and sample

The study's intended study or treatment population is the population of interest. It is frequently inappropriate or impractical to include the full target group in research investigations. Instead, to include the target group in their study, researchers will draw a sample from the relevant population. In these situations, the goal of the research study is to extrapolate the study results from the sample to the relevant population (Majid, 2018). The following subsections discuss the population and sample used in the current study.

3.6.1 Population

Qualitative analysis is thought to include a limited number of participants, and the investigator inductively analyses the data by categorising them and grouping them in patterns that show narrative synthesis (Gay et al., 2012). Gay et al. (2012) note that a populace may be any measure and may cover almost any topographical zone, entire group of interest to the researcher is rarely available. In this way, a distinction is made between the population to which the researcher would ideally like to generalise study results, the target population, and the population from which the researcher can realistically select subjects, which is known as the *accessible population* or *available population* to which study outcomes were generalised. Therefore, the population of this study included all Grade 7 Mathematics teachers and learners from schools in the Otunganga Circuit, Ohangwena Educational Region, Namibia. The circuit consists of 27 schools and 31 Grade 7 Mathematics teachers, and ±1 050 Grade 7 learners.

3.6.2 Sampling

As characterised by Trochim (2002), sampling is the technique of choosing participants from a population of interest so that, by examining the sample, one will be able to generalise the outcomes by looking at the population from which they were taken. This representative part of the population is called a sample. Therefore, I applied the homogeneous technique of purposive sampling. Gay et al. (2012) characterises homogeneous selection as selecting partakers who are exceptionally comparative in the encounter, point of view, or viewpoint. This gives a contract, homogeneous sample for information collection and investigation. For the purpose of this study, a homogenous sampling technique allowed for the participants to have equal chances of presenting digitalised lessons and for learners to have the same experiences of being taught with digital tools. Only schools in the circuit with digital resources were chosen.

The sample for this research study consisted of two Grade 7 Mathematics teachers and 86 learners from two schools. Of the 86 learners, 30 were purposively selected to undergo the interviews after the topic presentations were completed, but only 26 learners managed to partake in interviews, four of them withdrew from the study without supplying any reasons. The selected teachers are teaching at schools that are well equipped with digital tools, that is, computers and overhead projectors that this study portrays as the main tools that teachers could use as a way of integrating technology in teaching. Thirty learners were selected depending on how they actively took part in lessons. This was to probe learners for more data that could be helpful for the study.

3.7 Data collection instruments

The study used interviews and observations as data collection instruments. Hence, the study constructed meaning from the data collected through interviews and observations to answer the research questions and reach its aims and goals. This overview emanates from the constructivist paradigm. Kivunja and Kuyini (2017) discuss that the central endeavour of the interpretivist paradigm is to understand the subjective world of human experience. This approach makes an effort to "get into the heads" of the subjects being studied, and to understand and interpret what the subject is thinking or the meaning s/he is making of the context. Every effort is made to try to understand the viewpoint of the subject being observed, rather than the viewpoint of the observer. Emphasis is placed on understanding the individual and their interpretation of the world around them. Under this paradigm, the researcher made use of the data gathered through interviews (open-ended) and observations (Rehman & Alharthi, 2016; Kivunja & Kuyini, 2017).

3.7.1 Interviews

The research interview is a data collection method in which participants supply information about their behaviour, thoughts, or feelings in response to questions posed by an interviewer (Crano & Brewer, 2001). Interviews are used when researchers need to interact with participants. The interviewer asks questions to receive information from the interviewee. Qualitative researchers use structured interviews, semi-structured interviews, and unstructured interviews as data collecting instruments. The interviews were done by interviewing two Grade 7 Mathematics teachers and 26 learners through semi-structured interviews.

Dawson (2002) explains that semi-structured interviews provide the researcher with specific answers which may be compared with data obtained in earlier interviews. The same questions may be asked in each interview; however, the researcher also wants the interview to be flexible so that other important data can be generated.

To address the challenges faced by Grade 7 Mathematics teachers integrating digital technologies to teach Data handling, the TPACK theory was central in guiding the process. By conducting semi-structured interviews with teachers, 15 questions (cf. Appendix H) were asked among which some of the questions sought information mainly on the two questions of the study: 1) the challenges faced by teachers in integrating digital technologies in teaching data handling; and 2) how teachers and learners perceive the integration digital technologies in teaching (one of the sub-questions). Learners were interviewed based on their perceptions of the integration of technologies in teaching and learning (cf. Appendix I). They were also asked to present their views on working in groups while being taught Mathematics with the use of computers, the frequency of computer usage in teaching as well as the challenges they faced while being taught with a computer.

3.7.2 Observations

Bertram and Christiansen (2014) explain that observations allow the investigator to gather the information that the participants may not be able to talk about in the interview. Gay et al. (2012) states that the most common forms of observation in qualitative research are participant and non-participant observation. Furthermore, Gay et al. (2012) notes that in participant observation, the viewer becomes part of the situation and takes part in it when seeing and gathering data. A non-participating observation means that the observer does the observation and recording without interacting or taking part in the location of the study. For this study, non-participant observation was used.

Non-participant observation is a qualitative data collection method where the researcher observes the subjects without becoming actively involved in the situation being studied. This approach allows for the collection of data in a natural setting, providing insights into behaviours, interactions, and social dynamics as they occur organically (Choudhury, 2015; Gay et al., 2012). The researcher observed two teachers teaching Grade 7 data handling to understand the challenges that teachers are faced with by observing how well the classrooms are equipped with digital resources, teachers' knowledge of technology integration into teaching, knowledge of technology as a teaching method, teachers' content knowledge in relation to technology as well as how the knowledge aspects influence teaching and learning (cf. Appendix G).

3.8 Research Process

To interact with participants, observations were conducted as a first stage of engagement with teachers and learners as they interact in the classroom in the data handling content area. To understand the participants' perspectives in relation to observed interactions, interviews were

conducted with participating teachers and sampled learners.

3.8.1 Observations

The observations were conducted first for four days at each school. Three of the lessons at each school lasted for 40 minutes and the fourth was a double (80 minutes) lesson from both schools. During the observations, the lesson presentations were recorded with a video camera while also taking notes with reference to the observation checklists (cf. Appendix G). The aspects observed were: 1) how well the classrooms were equipped with digital resources; 2) teachers' knowledge of technology integration in teaching; 3) knowledge of technology as a teaching method; 4) teachers' content knowledge in relation to technology; and 5) how the knowledge aspects influence each other in teaching and learning. However, since each day had different competencies to be covered, aspect number 4 was observed in accordance with the competencies, since it is based on the competencies of the topic.

While integrating all the aspects, on day 1, the participants were observed covering the competencies 1 and 2 and it was observed whether the teacher used technology to show: expertise knowledge of how to design and use yes/no and/or multiple-choice response questionnaires to collect data; and knowledge of how to organise and record responses from questionnaires on tables and tally charts. On day 2, the competencies observed were: knowledge of how to represent data on various types of bar graphs, broken line graphs, pictograms and pie charts (with not more than four sectors); and knowledge of how to extract and interpret information from tables, bar graphs, pictograms and broken line graphs. On day 3, the observation was of: expertise in extracting and interpreting data represented in pie charts (with not more than four sectors, including measuring angles) and converting them to data; and day 4, showed expertise in finding the mode, median and mean of a set of data and draw

conclusions and/or make predictions.

3.8.2 Interviews

The interviews followed the observations; teachers were interviewed first and learners later. Interviews were recorded with an audio recorder and were later transcribed. Teachers opted to teach first while attending to the interview questions later so that they were able to prepare their responses. Follow-up questions erupted as interviews were progressing and the responses are integrated in the analysis of the main questions. A total of fifteen questions were asked of teachers, whereas eight questions were asked of learners. Two Grade 7 Mathematics teachers (one from each school) and 86 learners were observed throughout the topic presentations and the same two teachers were interviewed and 26 learners were also interviewed. The names of the participants were not used in the study, instead, the pseudonyms were used as Teacher A from School A and Teacher B from School B for teachers and, for learners, Learner 1A to 15A (LA1-LA11) for School A and Learner 1B to 15B (LB1-LB15) for School B, were used. The schools' names were also not used in the study to keep the participants anonymous and protected. The schools were instead presented as School A and School B.

3.8.2.1 Teachers' interviews

A total of fifteen questions were asked in the interviews with the two teachers, including questions about their biographical information. The researcher asked the participants a sequence of five questions, then, after a break, the next five questions until all the questions were asked. The duration of the interview excluding the breaks was initially estimated to take 30-40 minutes but it varied around 25 minutes for each participant.

With reference to Appendix H, the following questions were asked to teachers during the interviews. The first and second questions of the interview were about finding out about

teachers' technological skills and experience in teaching Mathematics and whether they had been trained. The following questions were asked: 1) Talk about your technological skills of teaching data handling and about your experience of teaching Mathematics; and 2) Have you undergone training in creating graphs, pie charts and tally marks using a computer? The study also wanted to find out the method that teachers mostly used in terms of technology usage versus the traditional methods of teaching, so the next two questions that were asked were: 3) How do you understand technology integration into teaching, and do you often integrate technology into your teaching? 4) Do you always integrate technologies into teaching Mathematics? To study the challenges faced by teachers integrating digital technologies in teaching Mathematics as a subject and Data handling as a topic, the following questions were asked: 5) What challenges do you encounter when integrating digital technologies into teaching? 6) How easy/difficult is it to integrate digital technologies into teaching Grade 7 Mathematics? 7) How easy/difficult is it to integrate digital technologies into teaching data handling in Grade 7 Mathematics? Questions on teachers' perceptions on technology, as a pedagogical method, were posed to the participants as follows: 8) What do you think is the impact of technology on Namibian education? 9) Do you think it is relevant/necessary to integrate technologies into teaching data handling in Grade 7? 10) What are your perceptions about teaching data handling in Grade 7 with the integration of digital technologies? Regarding the availability of digital tools at schools, the teachers were asked the questions: 11) What other types of digital technology for teaching do you know, and which ones do you have at your school? 12) What types of technology in your school do you mostly use? 13) Do you think your school is well equipped with technological tools that can be used for integration into teaching? Suggest any improvements. Further, teachers were asked to express whether the curriculum is designed in a way that technology can be integrated through this question: 14) Do you think the curriculum gives enough room for technology integration into teaching?

Finally, the teachers were asked whether the integration of digital technologies in teaching can improve learners' performance through this question: 15) Do you think the integration of digital technologies into teaching data handling in Grade 7 can improve the learners' performance in the topic?

3.8.2.2 Learners' interviews

Learners were asked eight questions (cf. Appendix I); 86 learners were observed in their interaction with the teacher throughout the classroom engagements. In addition, 30 learners were purposively selected and interviewed. Each interview took about 15 minutes. As discussed in Chapter 1, 15 learners were selected from each school, but four of the learners from school A withdrew without supplying reasons. The classes had 27 learners in school A and 32 learners in School B (total: 54). The total number of learners from the two schools was 86. Learners were selected to take part in the interviews according to their active participation in the class.

Learners were mainly asked to express their perspectives on the integration of computers to teach by answering the following questions: 2) how do you feel about using computers in school? and 4) how did you find teaching in a computerised classroom; was it interesting or not? To find out about how technology enhances learning through group discussions, these questions were asked: 1) how is your performance in Mathematics in general? 3) how did you feel learning in groups where technology was being used? and 5) how do you think that computerised lessons have helped you to improve? Learners were also asked about the frequency of computer integration in teaching Mathematics as: 6) Does the teacher always teach Mathematics with the use of the computer? Finally, learners were asked about the challenges they came across while being taught data handling with a computer and what they

missed during the presentations: 7) what did you miss during the presentations and what do you think caused that? and 8) I saw that some of you could not correctly do some parts of the activities you were given, why? (cf. Appendix I).

3.9 Data Analysis Strategy

Data analysis in qualitative research leads to the presentation of findings (Gay et al., 2012). Bhatia (2018) notes that qualitative data is obtained from words, observations, pictures, and even signs and that analysis starts as soon as data is accessible. Bhatia (2018) further explains that analysis includes four steps: familiarisation with the data, revision of the research goals, creation of a structure, and identification of trends and connections.

The data analysis of this research was done through the *deductive thematic data analysis* approach to analyse the collected data from diverse sources that include interviews with participants and field observations. Adopted by Braun & Clarke's Thematic Analysis, the deductive thematic data analysis method involves a six-step process: familiarisation with the data, coding, generating themes, reviewing themes, defining and naming themes, and writing up (Caulfield, 2023). The method was suitable for the study since it helped the researcher to systematically find, organise and offer insight in patterns of meaning across a dataset and to make sense of collective shared meanings and experiences (Braun & Clarke, 2012). Most deductive theme analysis is conducted using the researcher's theory or analysis, according to Javadi and Zarea (2016), and entails approaching the data with some preconceived notions you expect to see reflected there, based on theory, or previously held knowledge (Caulfield, 2023).

Data gathered through audio interviews were transcribed and the researcher took notes during the first step of the analysis. Secondly, the data were coded deductively (dependent on the theoretical framework). Thirdly, codes were combined in themes that were then reviewed in

the fourth step. The themes were then defined and named according to the theoretical framework. Lastly, the themes were presented for discussion.

Data were analysed upon collection. I read the collected data thoroughly to recognise trends. To supply detailed explanations, the researcher reviewed the data in depth. The data were then classified, coded and divided into themes. The collected data were narrated in sections that responded to the questions of the study to draw conclusions and practical solutions were recommended. The researcher interviewed two teachers from the two schools in which 16 open-ended questions were asked of each participant. Seven more questions were asked of 26 learners, 11 learners from school A and 15 from school B.

The questions were crafted to seek answers for the main research question as well as the three sub-questions. The responses of the participants were then coded following the four questions of the study and guiding theory. The responses of the participants were then compared and coded.

3.10 Trustworthiness

Validity, transferability, and genuineness are terms that are used to confirm the reliability of qualitative content analysis (Elo et al., 2014). Furthermore, Gay et al. (2012) state that the *trustworthiness* of data should be based on real observation, from reliable participants and not biased. For the trustworthiness and validity of the study and data collected, semi-structured interviews and observations were used to collect data.

The narratives of the data were based on the participants' words and concepts. The interviews were recorded on audiotapes and transcribed later to draw patterns, codes, and themes. Concurrently, the observations were video recorded to be studied after the presentations. The researcher obtained permission from the participants. Field notes were also taken to be

compared with the recorded observations. The two methods used in data collection helped to *triangulate* the data. This confirms data as it compares the data collected from two or more instruments of data collection (Pope & Nicholas, 2020). Furthermore, according to Pope and Nicholas (2020), triangulation tests the validity of data by assuming that any weaknesses in one method will be compensated for by strengths in another, or that agreement between findings from two different methods can be interpreted as strengthening the confidence that can be placed in the findings.

3.11 Research ethics considerations

Cavan (1997 cited in Cohen et al., 2018:112) defines ethics as "a matter of principle sensitivity to the rights of others". Cohen et al. (2018) further emphasise that educational researchers must take the effects of research on the participants into consideration.

Authorisation to carry out this study was obtained from the University of South Africa (Unisa). An ethical clearance certificate with reference number 2021/09/08/61942553/18/AM was obtained from the University before the commencement of data collection (cf. Appendix A) Permission to visit schools to collect data for the purpose of this study was also sought from the office of the Ohangwena Region education director, see the attached permission letter as Appendix B. Upon receipt of the permission from the regional director, the researcher wrote letters to the school principals of the participating schools (cf. Appendix C). Teachers and learners were also presented with consent and assent letters, attached as Appendices D (for teachers) and F (for learners) to inform and request them to participate in the study through the offices of their respective principals. Consent letters were also sent to the parents of the participating learners to allow their children to take part in the study and learners were given assent letters (cf. Appendix E). The participants were engaged and the purpose of the study was

explained. All participants agreed to take part in the study, including parents through signed consent forms.

The times to carry out the interviews were discussed with the director, inspector, school principals and the Grade 7 Mathematics teachers and learners. The confidentiality of participants was reinforced, and participants did not provide their names during the study. All the collected information will be kept confidential and used for the purpose of this study only. Data will be kept for five years in a safe place where no one will have access to it and will be permanently destroyed thereafter. Both teachers and learners were notified that their participation was voluntary and if they agreed to partake, they had the right to withdraw from the study at any time.

3.12 Chapter Summary

Chapter 3 outlines the research design as a vital structure that unifies all components of the study, using empirical data to answer research inquiries. It explores the interpretivist view, recognizing that personal experiences influence reality, making knowledge subjective. This view helps understand the obstacles Grade 7 teachers face when integrating digital tools in teaching data handling. The chapter emphasizes qualitative methods for grasping phenomena in their context and explains the single case study approach, focusing on Grade 7 Mathematics educators and students. It justifies the choice of participants from two Namibian schools and identifies interviews and observations as key data collection methods, reflecting the constructivist paradigm. The chapter also details a six-step deductive thematic analysis for data examination, discusses the study's trustworthiness, and covers ethical considerations, concluding with a recap of the research design and methodology.

Chapter 4
Data Presentation and Analysis

4.1 Introduction

This chapter presents the analysis of the data collected through the interviews and observations at the two participating schools. The data analysis was based on the themes that emanated from the teachers' and learners' responses to interview questions and the researcher's observations. The biographical information for teachers was based on their teaching experience, age range as well as qualifications, while learners' information was about their gender and school.

Table 4.1: Teacher participants' biographical information

Participants and their schools	Gender	Qualifications	Teaching experience	Age range
Teacher A (School A)	Male	BETD, B Ed. Honours (Mathematics Education)	More than 10 years	38 – 45 years
Teacher B (School B)	Female	B Ed. Honours (Mathematics Education)	2 Years	27 – 33 years

Table 4.2: Interviewed learner participants' biographical information

School:	The number of learners:	Gender	
		Male	Female
School A	11	5	6
School B	15	6	9
Total:	**26**	**11**	**15**

Teacher participants' differences in teaching experience did not influence their responses to the questions, nor did they reflect significant differences in the use of digital tools. The difference in gender of learners, more females than males, also did not influence their responses.

4.2 Presentation of teachers' semi-structured Interviews

During the analysis of the data, several themes emerged to answer the research questions of this study. The themes that emerged from teachers' responses are discussed under each concept. Nine themes emanated from teachers' interviews that were: (1) teachers' technological skills and teaching experience in Mathematics; (2) designing and teaching with digital tools; (3) training on teaching Mathematics with the use of digital tools; (4) technology versus traditional methods; (5) challenges of technology integration with teaching; (6) perceptions of technology integration with teaching; (7) availability of digital tools at schools; (8) the curriculum and technology integration in teaching; and (9) technology integration towards learning. The themes are hereunder discussed accordingly.

4.2.1 Teachers' technological skills and Mathematics teaching experience

Teachers are the cornerstone of making meaning in teaching with the use of technology. Therefore, they must be knowledgeable on what and when to use suitable technologies for effective teaching and learning in the classroom. Teachers were engaged in a discussion about their technological skills and experience in teaching Mathematics. The following question was asked: Talk about your technological skills of teaching data handling and about your experience of teaching Mathematics. Teacher A said that his technological skills include *word processing skills (typing), spreadsheets, an electronic presentation (PowerPoint) and scanning.* Teacher A further alluded that, as teachers, they *rely on a computer, and also use a computer to show*

learners videos. Teacher B responded that they are conversant with *printing and showing learners videos using a laptop.* The skills that teachers mentioned are basic skills that computer users should have regardless of the subject they teach or any other type of carrier. However, the skills that teachers highlighted in their responses indicated that teachers have adequate technical skills to present digitalised lessons. Figure 4.1 shows the summary of teacher' technological skills.

Teachers also indicated their teaching experiences on the subject. Teacher A responded that he had taught the subject for nine years, although that is not his actual teaching experience, (refer to Table 4.1), while Teacher B had taught the subject for two years. Teacher B expressed that she was not well experienced with the subject as she had just started teaching it. Teacher A responded: "*I have been teaching Mathematics for nine years*" while Teacher B responded: "*I do not have much experience because I just started teaching Grade 7. This is my second year of teaching Grade 7. So, I do not have only one year of experience.*" Their teaching experiences, however, did not affect their teaching strategies, nor did they have a significant difference in how they presented their lessons or how they responded to the questions posed to them.

As shown in Figure 4.1 teachers indicated that they had technological skills that they can employ in their classrooms to teach data handling. They used skills, such doing operating a computer to prepare PowerPoint presentations, operating spreadsheets, typing and searching for videos to show to learners, for a successful technology-based lesson.

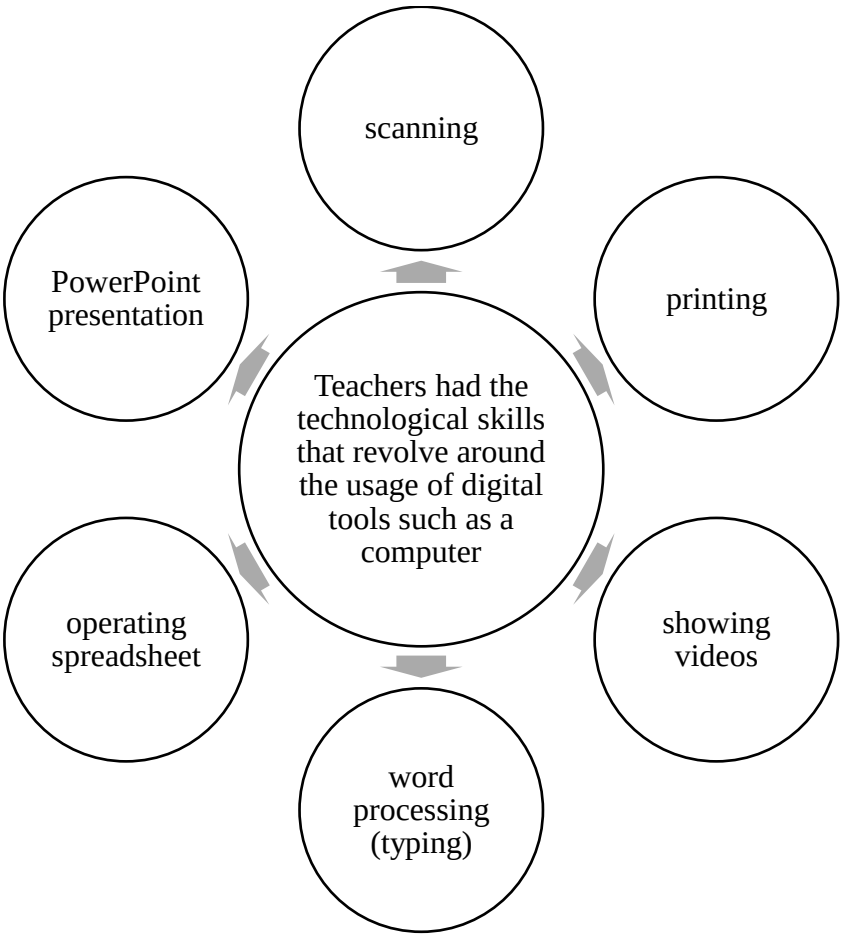


Figure 4.1: Teachers' technological skills

The data on teachers' technological skills shows that teachers have adequate basic skills that they can apply to present digitalised lessons. Teachers can type and design figures, draw tally tables, graphs, and pie charts to present and explain on a PowerPoint presentation. Despite their difference in teaching experiences, teachers reflected that they were able to utilise digital tools to present the lessons adequately.

4.2.2 Designing and teaching with digital tools

Designing and teaching with digital tools are critical in the mathematics classroom, however, challenges are experienced. The teacher participants showed skills in designing and presenting digitalised lessons (see Table 4.7). Table 4.7 shows some of the presentations that teachers

prepared for teaching the topic. The presentations reflect skills in making use of the method to teach. Data however reveals that there is a lack of full integration of technologies with teaching and that teachers switch from utilising digital tools to using traditional tools such as writing on the flipchart. Figure 4.2 shows parts of a presentation where the teacher switched the methods.

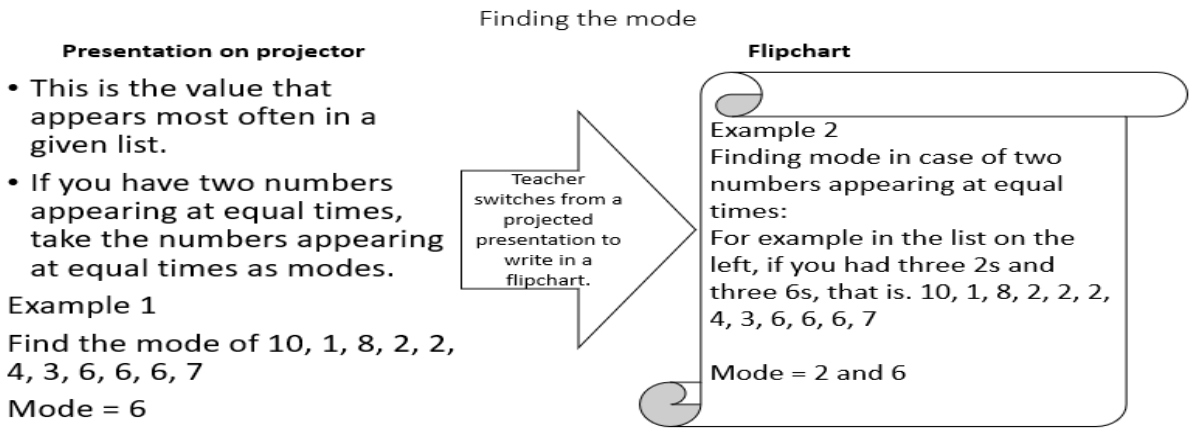


Figure 4.2: Combination of teaching modes

Data revealed that teachers are more used to the traditional ways of teaching and could not keep up with digital tools. Thus, switching between the two methods. Teacher B did mode, median and mean calculations on a flipchart (see Figure 4.2). Designing lessons utilising digital resources as well as teaching while integrating the digital resources is a challenge, though essential. Figure 4.3 shows the hierarchical analytical findings of the tools used to design lessons that include the hindrances as well the outcomes.

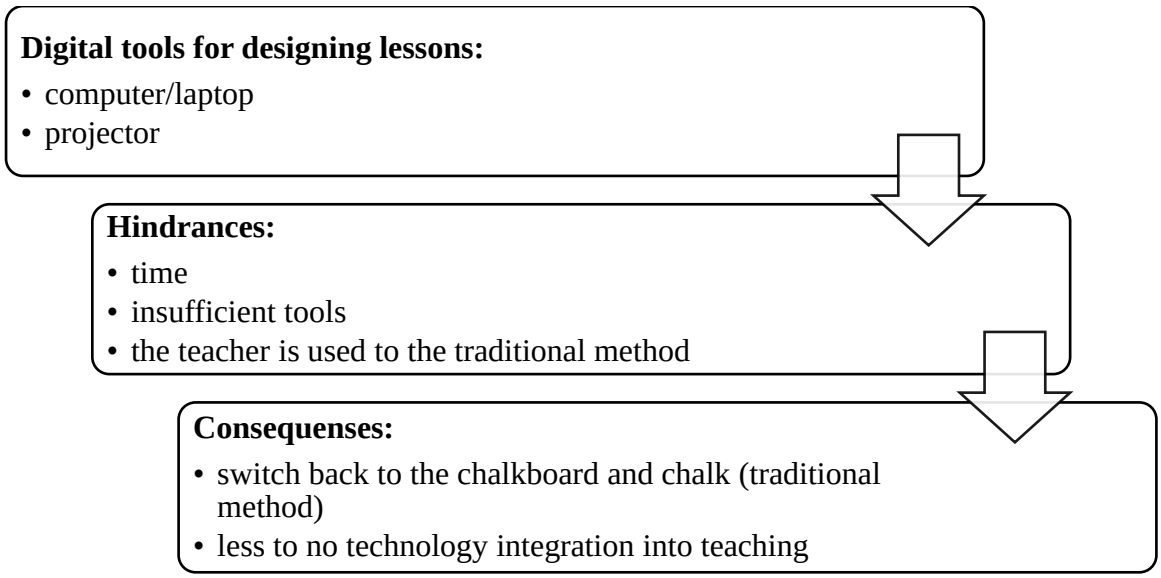


Figure 4.3: The flow of designing and presenting digitalised lessons

The data revealed that teaching and learning with presentations that are prepared and designed with digital tools are not normally practised at schools. Besides the insufficiency of digital tools at schools, it is also clear that teachers mostly use traditional ways to teach. The switch from using the presentation on the computer to using a flipchart for further explanations is evidence that teachers mostly teach with either flipcharts or chalkboards and not with the use of digital tools.

4.2.3 Training on using digital tools to teach Mathematics

Teachers were asked whether they had gone through training on how to utilise digital tools to create graphs, pie charts and tally marks to teach Mathematics. Both teacher participants responded that they had not been trained to integrate technology into teaching Mathematics. Teacher A responded, "*Not really, I acquainted myself with the tools and also try to train myself using available tools, I did not get proper training.*" while Teacher B responded, "*No, I did not go under any training.*"

A lack of formal training was therefore one of the hindrances towards the integration of

technologies in teaching. Teacher A emphasised that training was a challenge by saying:

> *"There's a lack of expertise and experience on how to use them. As I have said earlier that we have not yet received the proper training on how to use them. Most of them, are underutilised. Our teachers need the proper training on how to use those materials. But we are trying with the little knowledge that we have."*

Pre-service training and in-service training can play a significant role in including the use of technologies in lesson deliveries. Based on participants' responses, evidence surfaced that there was a lack of proper training on technology integration in teaching either through training institutions for pre-service teachers or through CPD for teachers in service.

4.2.4 Technology usage versus the traditional method of teaching.

Teachers were asked whether they always integrate technology in teaching the subject. Although the participants admitted that the integration of digital technologies in teaching is one of the best ways of teaching and can improve learners' performance, they still felt that they were attached to the use of the traditional methods, that is, the *chalk and chalkboard* method of teaching, although sometimes they made use of technological sources, such as videos, printed resources and internet searching, when teaching. Teacher B shared: "*I do not always use technology, in most cases, we use traditional ways of teaching whereby we use the chalkboards.*" Similarly, Teacher A referred to other teachers as using "*traditional methods: chalk and chalkboard.*" The participants expressed that the use of the computer was time-consuming and required much time to prepare lessons, hence they preferred teaching with the use of a chalkboard. Figure 4.4 reflects teachers' responses to the use of the two methods of teaching. The figure shows the imbalance between the methods as technology is underutilised.

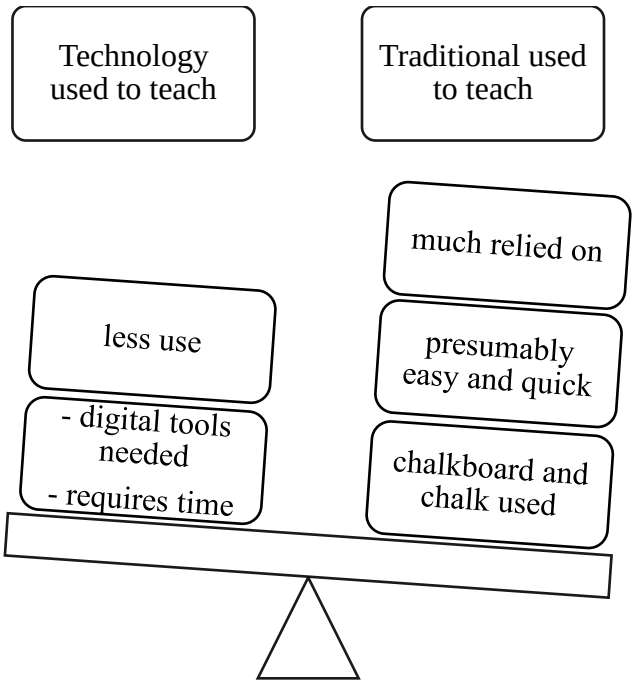


Figure 4.4: Imbalances between technology usage and non-usage

The findings in this section are that traditional methods, as opposed to digital tools, are mostly in use at schools. It was further revealed that teachers prefer traditional methods to digitalised presentations.

4.2.5 Challenges of technology usage to teach

The teachers were asked about the challenges they encountered when integrating technologies in their teaching (question 5); how difficult it was to integrate technologies in the classroom (6); teaching in Mathematics as a subject; and (7) teaching data handling as a topic.

Teacher B's response to the question of challenges was that sometimes the teacher may need to do more explanations and step-by-step calculations for learners to catch up when presenting:

> *"Some learners are fast learners while others are slow and doing calculations, for example, with the mean, mode and median competencies, becomes a challenge. You will need more practical explanations which may not be possible when using*

digital technologies."

Teacher A, however, spoke about the availability of technological tools and how they are used in teaching and learning. The teacher expressed that some schools do not have technological tools. Moreover, the teacher expressed the need for training and skills among teachers to be able to integrate technologies in teaching.

Questions 6 and 7 were based on how difficult it was to integrate technologies in teaching (6) Mathematics as a subject and (7) data handling as a topic. Teacher B expressed how learners may not catch up with the presentations saying, "*our learners here in the village are not used to the technology integration in teaching and learning, and it is difficult because they are used to the traditional ways of teaching and learning.*" The teacher explained that, since they are teaching in village schools where learners are not exposed to technologies, it is sometimes challenging for them to integrate technologies in teaching Mathematics as a subject. The teacher further explained that "*learners may not easily catch up with the explanations and are mostly used to the method of teaching and learning with the use of a chalkboard*." The teacher also said that "*the use of technology limits the way the teacher can explain the content in comparison to the use of traditional methods*." Furthermore, the teacher expressed that the integration of technology limits the way they explain to learners by stating that "*I think it is limited when you are using technologies, you will not be able to explain more.*"

Teacher A responded that challenges would depend on the technological materials available at the school, training, and skills that teachers had in the utilisation of the available technologies. The teacher affirmed that "*the challenge is that some schools do not have the technological materials, but they want to integrate, some do not have the skills.*" The teacher further expressed that materials, training, and skills are required at schools for the successful

integration of technologies in teaching, confirming that "*all we need is just to have the materials in place, training and then to have the skills.*" The teacher however described some easy activities to do on the computer such as "*writing words and entering numbers*". The unavailability of technological tools in schools and the lack of training among teachers therefore hinder the integration of technologies in teaching and learning.

On the integration of technologies in teaching Mathematics as a subject and in teaching data handling as a topic, the teacher mentioned the difficulties that included the creation of graphs for presentations by affirming that "*the difficulties come when you are trying to create the graphs, the bar graphs, pictograms, pie charts and tally marks, it is sometimes challenging.*" The teacher emphasised that sometimes it could even get more challenging when they are trying to get information during the presentation, for example, looking for a picture. The teacher further expressed how learners sometimes also become an issue to control during the presentation, noting that "*when learners see the graphs, for example, they get carried away by the colours and lose concentration on the content of the presentation since it is something new to them.*" Thus, the teacher struggles to keep concentration in the classroom. The teacher said that this mostly happens because learners are not used to the method. The teacher expressed that it could apply to both the subject and the topic. Figure 4.5 outlines the findings of challenges faced by teachers with suggested effects.

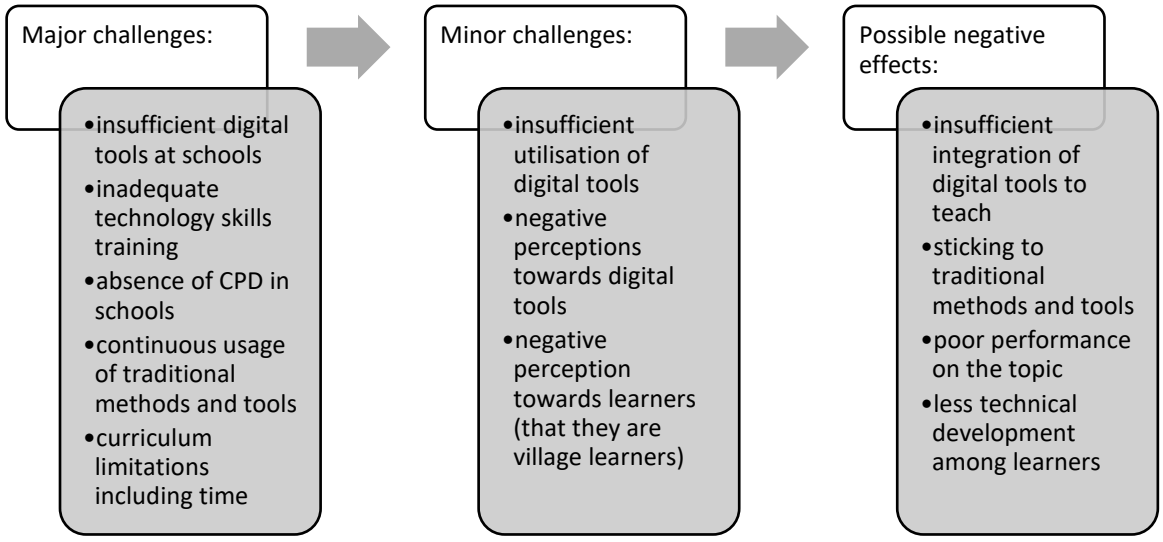


Figure 4.5: The challenges faced by teachers in utilising digital resources

This section reveals several challenges that teachers faced with the integration of technologies that included more time required to prepare digitalised presentations, the insufficiency of digital tools in schools, negative feelings towards the method, curriculum limitations, and insufficient training (either through CPD or pre-service), among others.

4.2.6 Teachers' perceptions on technology as a pedagogical method

Teachers mostly acknowledged the integration of technologies in teaching as helpful on improving teaching and learning, however, they had mixed perceptions towards the method. Their responses to the three questions: (8) the impact of technology on Namibian education; (9) the relevance of technology integration in teaching; as well as (10) their perceptions about technology integration in teaching data handling, attested to this.

In response to the questions, Teacher A favoured the integration of technologies by acknowledging that it exposed learners to many ways of learning and captured learners'

attention during presentations. The teacher further expressed that technological tools also give teachers opportunities to effectively deliver their content with fewer explanations and provide learners with more exercises. The teacher expressed that:

> *"It exposes learners to a variety of teaching methods by using different tools and captures learners' attention to listen to what the teacher is presenting, proving to be a great deal and advantage in the delivery of fair quality education. It creates more exercises that you can give to learners, assuring effective lesson delivery and encourages not only learners but teachers too to create more interest in the topic that the teacher is teaching."*

On the relevance of digital technology integration in teaching, the teachers narrated that there was a need for the utilisation of digital tools in teaching for the demands of the current world. For example, Teacher A asserted that "*the world is changing, and we need to change our formal way of doing things too.*" Teacher A further attested that technological integration improves the way Mathematics is taught as "*it improves Mathematics teaching styles; it establishes a unique character of teaching Mathematics and provides a lot of strategies for teaching.*" The teacher further expressed that the integration of technologies "*improves learners on their interest in the content and encourages them to become good participants of the discussions*", thus putting them at the centre of the teaching and learning process. Teacher A further noted:

> *"They get to love the subject and it subsequently helps them to be able to recall what they have been taught for a long period, sometimes even for a lifetime. It encourages co-operation among learners because, after the presentation, you must give an activity."*

Teacher B's response to the questions expressed mixed perceptions towards the impact of

technology in teaching, expressing that it is sometimes good and sometimes bad. It is good "*because it makes the work easier.*" The teacher expressed however that it is sometimes bad: "*… for example, if you bring [learners] in the computer lab and give them computers and tell them to search for something, they may end up searching for other fun things*", that is, things that are not related to the lesson. The teacher said, "*for example, the boys even end up watching unnecessary things on the internet that is not educational.*" This would require the teacher to monitor learners' searches that would take from the time needed to deliver the content. Teacher B however acknowledged the integration of digital tools in teaching as relevant and responded that "*it is necessary to integrate technologies in teaching, as I said, it makes the work easier, and you are not even going to draw.*" Teacher B further expressed that learners learn differently, and the integration of technologies would accommodate all learners as "*some learners are fast learners and others are slow learners.*"

Teachers' responses to the questions show that the integration of digital technologies in teaching is beneficial for learners. Hence, they have welcomed the method in their teaching. Participants, however, do not fully implement it in their presentations. This could be due to the hindrances they have expressed in other responses.

4.2.7 Availability of digital tools at schools

Digital tools at schools include computers, laptops, printers, scanners, Wi-Fi/internet connections and projectors. At the participating schools, the computers, scanners and printers are situated in the administration block and administered by the administration staff. The schools are equipped with a computer lab with several computers, a projector (one at each school) and smartboards which were, however, dysfunctional at both schools. Both schools had functional Wi-Fi connections. The equipment available did not enable full integration of

technology with teaching because the primary function of the computer lab is only for teaching Information Communication (IC). Participating teachers had to plan with the IC teacher to make use of the computer lab.

Their answers to the question on how well the school was equipped differed. Teacher A responded that they are well equipped as they have "*received a donation from the Millennium Challenge Association … we have about 60 smaller laptops for learners and 30 for teachers*." The teacher, however, expressed that the materials were not being effectively utilised because "*there is still a lack of skills among teachers on the utilisation of the equipment and teachers need proper training on how to use the materials effectively.*" The lack of materials that the teacher referred to was because the school had a population of about one thousand learners and ±40 teachers, and those materials were only meant for the IC subject.

On the other hand, Teacher B narrated that the school was insufficiently equipped with technological tools. The teacher stated that "*they only have one room that is equipped with technological tools*", that is, the computer lab that cannot cater for all the school's technological needs. The teacher emphasised that "*if the school was well equipped, each class could have its smartboard and each class must have a computer, so the school is not well equipped with technological tools.*" The teacher further suggested that the Wi-Fi be strengthened to reach all classrooms "*so that we can use the network to download even videos and other things that we need to use in the class, as now it only covers the surrounding of the main staffroom*."

Both schools received donations from the same association (MCA), at the same time. Their donations were the same in terms of technological equipment, that is, every school got Wi-Fi, a computer lab with learners' laptops, laptops for teachers, a smartboard as well as a projector or two. As such, both schools fall under the same category and have the same needs for

improvement even though the two teachers have different perceptions about the availability of technological tools.

4.2.8 Curriculum and Technology Integration

In response to the question 14 on whether the curriculum gives enough room for technology integration in teaching, teachers detailed that the curriculum had not been interpreted well by teachers since its revision. Teacher A stressed that "*not to a full extent because the curriculum was even just recently revised, and teachers did not receive training on how to properly interrelate the syllabus with digital tools.*" Furthermore, "*teachers have not been trained in the use of digital tools to teach*." Teacher A continued to articulate that "*teachers need training on how to use the technological tools available at schools.*" Teachers expressed that much time is needed to prepare digitalised lesson presentations, and at the same time the content of Mathematics in Grade 7 requires much time to be fully covered over the academic year. Additionally, teachers raised a concern that even if the curriculum requires the integration of digital tools in teaching and learning, some schools lacked the necessary equipment for technological integration in teaching, such as computers. Teacher A highlighted that "*there is lack of technological tools in many schools*" and Teacher B stated that "*mostly the schools in villages do not have access to technology, you can go to a school whereby you cannot even find one laptop.*" Teachers also expressed that some schools do not even have electricity, "*we have schools where there is no electricity*" and both teachers responded that, due to these reasons, teachers will not be able to fully implement the curriculum with the integration of technologies.

4.2.9 Can the integration of digital technologies improve learners' performance?

In response to this question (question 15), teachers said that the integration of technologies

would significantly help with learners' performance because they would be motivated and interested in the presentations. Both teachers' responses attested to that. Teacher A said: "*Yes, because it increases learners' motivation and interest in the topic and improves their performance*" and Teacher B responded, "*It can improve learners' performance because they learn differently*." The respondents further showed that it would also help learners to be more engaged throughout the presentations as "*they would collect their information, organise it and interpret it*" thus giving them a chance to improve and to remember these activities during tests and examinations. PowerPoint presentations and videos allow learners to catch up with the subject content easily by seeing them. The teachers also emphasised that this would also help learners to learn by themselves, even when the teacher does fewer explanations. Teacher B stressed that "*some learners will just catch up with the content when they are reading the words from the presentation, even though the teacher did not explain well.*"

Based on the integration of technologies in teaching data handling, the teacher expressed that technology integration makes the presentation easier and faster and affirmed that "*I think, when it comes to teaching data handling, it makes it easier because if, for example, you are teaching graphs and pie charts, you can have them ready on the computer on PowerPoint. This is also good for learners who learn visually.*" The teacher further expressed that "*when you teach using the old way, it is time-consuming because you will have to draw those graphs on the chalkboard.*" Table 4.3 shows that the presentations are already prepared before the lesson begins thus saving time spent on drawing the graphs and writing the summary as it is done in the traditional methods of teaching.

This section reveals that the integration of technologies in teaching is important, and the findings further show that learners benefit significantly from the method. The method encourages learners to take part, promotes group work, reduces the time spent on drawings

during presentations, and helps learners to learn by seeing. These are beneficial reasons to use the integration of technologies in schools.

4.2.10 Teachers' interview summary

This study emphasises that teachers are the foundation in teaching with the use of technologies, and they must therefore be knowledgeable on how and when to use them. This study also found that teachers' technological skills are limited to using ready-made spreadsheets, videos, and programmes when they include digital technologies in their teaching. This study became aware of the hindrances to utilising digital resources in teaching data handling, such as insufficient digital equipment, lack of acclimatisation in using available digital resources and time spent.

The study further discovered that there is a lack of proper training for teachers on the integration of digital technologies in teaching. This could be a contributing factor to the challenges that teachers are faced with to utilise the available insufficient sources for technological integration. Similarly, the participants admitted that the integration of digital technologies in teaching is one of the best ways of teaching and can improve learners` performance, yet they still felt that they were attached to the use of the traditional methods, that is, the chalk and chalkboard method of teaching.

Teachers acknowledged that technological integration in teaching is suitable for the current world, but they still have mixed feelings towards it. They affirmed that it encourages learners to co-operatively work together. It is also good "*because it makes the work easier*", the participants noted. The method puts learners at the centre of the teaching and learning process which leads to greater achievements and improves learners' performances. Yet, the study learned that teachers also felt that some learners may not take advantage of the method since they are used to the traditional methods of teaching. However, this study believes that learners

are only getting introduced to the method, and, in the future, it will become a normalised practice across all grades.

The study further found that the availability of technological tools at schools could be one of the challenges faced by teachers. The available technologies are not equipped in classrooms but rather in the computer labs or the administration blocks where IC teachers and administrators mostly use the equipment. Should the classrooms be well equipped, teachers would use the equipment for the successful integration of technologies in teaching.

Teachers expressed concern that the curriculum had not been interpreted well to teachers since its revision. Teachers also raised a concern that some schools lack the necessary equipment for technological integration in teaching, such as computers and tablets. Some schools do not even have electricity and thus cannot fully implement the curriculum with the integration of technologies. Figure 4.6 below gives an overview of the findings on challenges as well benefits of technology integration in teaching. The figure shows that the challenges outweigh the benefits, and thus much would need to be done to overcome those challenges.

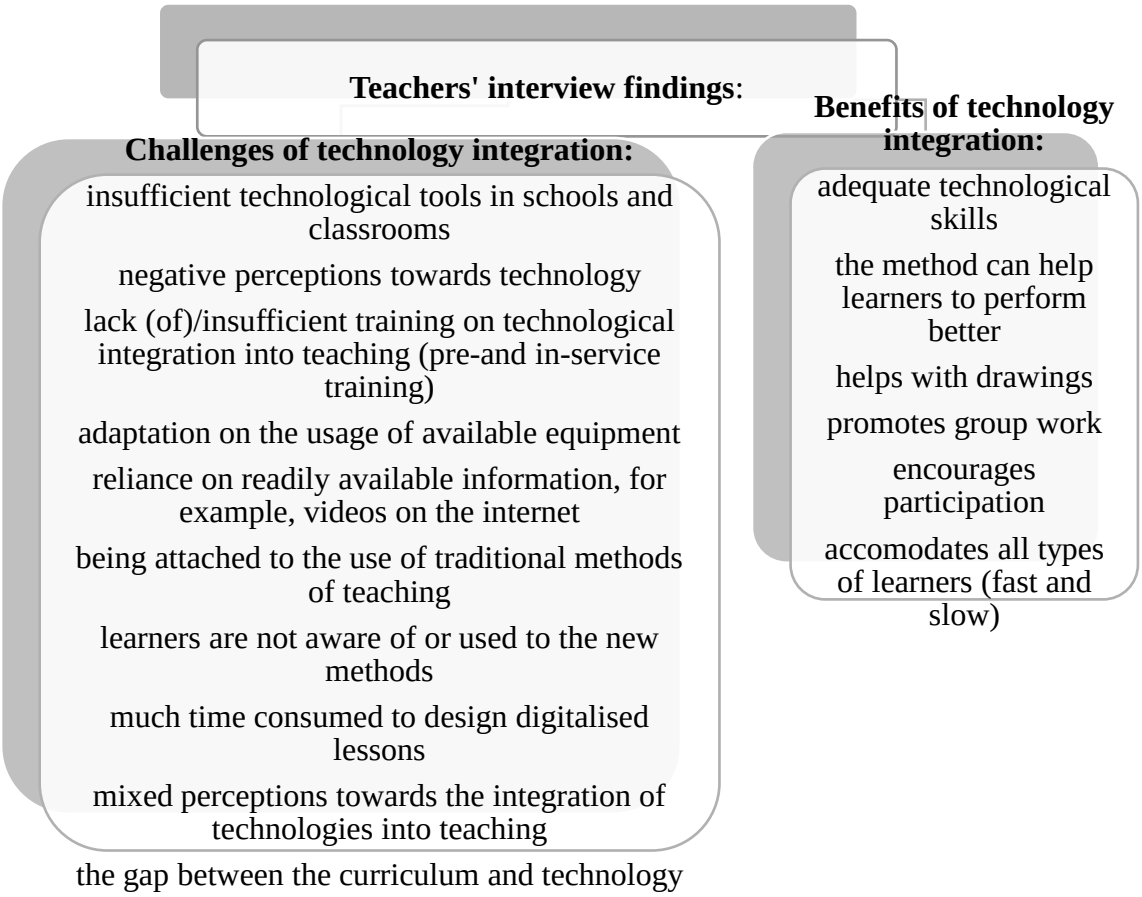


Figure 4.6: Summary of the findings of teachers' interviews

4.3 Presentation of learners' semi-structured interviews

For a better understating of learners' responses, the researcher edited the transcriptions as some of the responses were not understandable and some of the responses were given in the learners' first language, which is not English, hence, the responses quoted were not verbatim. While most of the learners tried to express themselves on each question, not all of them were able to answer all the questions. In some cases, the interviewer had to translate the questions into learners' first language to help them understand the questions and allowed them to answer the questions in their first language. The following themes emanated from learners' responses during the interviews: (1) learners' perspectives on computer integration in teaching and

learning; (2) the frequency of computer integration in teaching and learning; (3) how technology enhances learning through group discussions; and (4) the challenges that learners met while being taught with the use of a computer. Learners' responses have been combined and discussed collectively since not all learners were able to openly express themselves; most learners gave brief responses that the interviewer could not discuss separately.

4.3.1 Learners' perspectives on computer integration in teaching and learning

To find out about the learners' perspective on the use of computers in learning Mathematics, two questions were asked: (1) How do you feel about using computers in school? (2) How did you find teaching in a computerised classroom, was it interesting or not? While every learner who took part in the interviews showed their interest in computers at school, not many explicitly expressed their reasons for their interests. Learners A1, 5, 9 and 10, for example, just responded "*I am feeling very well*"; "*I am feeling very good*"; "*I feel happy*" and "*I feel well*" while Learners A6, 7, 8, 11 and Learners B1, 3, 5, 8, 10, 11 showed that they "*feel good/happy because computers provide us with information and answers*". Some learners showed that computers are used to search for information, get answers and watch pictures and videos. Table 4.3 outlines the details of learners' perspectives on using computers.

Table 4.3: Learners' perspectives on learning in a digitized environment

-I feel good because we learn so much information. We can search for information on the computers. *-I feel good because we can use computers to get answers by searching for them. Teachers also use them to teach (show videos and pictures).* *-It was interesting (most common response)*

-Interesting, because some subjects are difficult for us, and when the teacher uses a computer, it becomes interesting and helps us to improve the difficult subjects.

-It was interesting because we were never taught Mathematics with the use of a computer, it was my first time, and it is good.

- I wish that the teacher could continue teaching with a computer

- I understood better than when the teacher explains verbally to us

4.3.2 The frequency of technology integration in teaching and learning

Learners were also asked: (6) Does the teacher always teach Mathematics with the use of the computer? All learners responded that they were not usually taught the integration of technologies, and it was the first time that they were taught the subject (Mathematics) with the use of the computer and projector. Most of the learners' responses were simply just " *no*", with a few of them adding, "*it was only used during this topic*"; "*there are not enough computers at school*" or "*there are no computers in the classrooms that teachers can make use of*". Table 4.4 outlines the responses given by learners. They showed that they normally only used the computer lab during the IC lessons and that being taught with the use of a computer was a new experience. Learners tended to enjoy new things and were attracted to how the teacher used the computer which improved their concentration on the teacher's presentation. Their responses are outlined in Table 4.4 below.

Table 4.4: The frequency of being taught with digital technologies

- No, some learners responded with a "no" to this question. *<u>Their reasons were as follows:</u>* *- It was only used to teach data handling.* *- There are not enough computers to use at school.* *- Because there is no computer in the classroom that the teacher can make use of daily.*

4.3.3 How technology enhances learning through group discussions

Some of the activities were given in groups. Learners were asked how they felt learning in groups when technology was utilised. Learners responded that they felt good about it as it helped them to work together easily. It also helped them find answers together. Some learners also responded that working in groups gave opportunities to those who did not understand to ask others to help them and correct their mistakes. Another question was posed to learners about how they think computerised lessons helped them to improve. Their responses were that it helped them to improve because they were able to see, for example, the pictures that the teacher could not display on the chalkboard. They also stressed that it was interesting to see videos that clarified the discussions. However, a few learners expressed that they did not really see an improvement on their performance. For reinforcement, learners were asked about their performance in Mathematics in general. Many of them expressed that they performed very well. Some expressed that the method the teacher used to teach was good and some expressed that they liked the subject, and thus performed well. Table 4.5 shows a summary of the learners' responses to the questions.

Table 4.5: Learners' responses to questions 3, 4 and 5

Question 3
- I perform good; my performance is good; it is good (most common responses)
- I perform well when the teacher uses the computer
- I am good, I like Mathematics, because it is easy, it is not hard to me.
- My performance in Mathematics is that I am trying.
Question 4
-I felt better, because if you do not know, you can ask from others. Someone in the group who knows can help. It helps us to interact with others.
-I feel good, when the teacher gives the project, and you do not know, there are those that know, and you can work together and make it right.
-It is good that you learn more from others because some people know better than you.
-It is needed because when some learners do not understand, others can help to get answers and help each other.
Question 5
- It helped me because when you do not have a picture, you can use the computer.
- Not really much. I do not like computers much, I like when the teacher is using the chalkboard; that is how I can learn nice.
- Because sometimes you see photos. The teacher presents things we would not see on the chalkboard.
- It helped me to improve, yet I prefer to be taught with the use of a chalkboard.
- That we were taught in a faster mode that I like.

- I improved because when the teacher showed the videos, it helped me to understand the topic better.

- It helped me because I find it easier when we are taught with a computer, we also see different pictures.

4.3.4 Learners' challenges of learning with computer integration

Under this section, one of the questions was: "I saw that some of you could not correctly do some parts of the activities you were given, why?" Learners responded in different ways, such as that they failed since "*the teachers were either fast*"; "*have not given enough examples*"; "*learners are not used to the method being used*"; "*there were disturbances coming from either fellow learners or they were not listening at all*." Another question that was asked in relation to the challenges of learning with the integration of computers was: What did you miss during the presentations and what do you think caused that? A few learners indicated missing the tally marks presentation. However, some learners said that they understood everything during the presentations. Table 4.6 shows the learners' responses on what caused their poor performance on the activities. Learners' responses on the table could relate to the challenges of teaching and learning in digitalised classrooms.

Table 4.6: Challenges of learning with technology integration

- There are some things I did not get well, some I have forgotten, and like the tally charts, I did not hear it well, cos sometimes the teacher was fast, so I did not get it nicely (well). *- I almost got lost in the tally marks, because I did not understand them very well, but when I asked a friend who understood better, he told me what to then I got. I think this was a result of a disturbance from the learners who were seated at the back. They kept on trying to show something and I ended up not concentrating well.* *- Sometimes we do not understand well, and sometimes learners are just making noise and not listening to the teacher.* *- The method that the teacher used was new and I have not understood calculating the mode very well.* *- Nothing. For those that did not understand well maybe it was because the teacher was fast, or they were not concentrating.* *- I did not miss anything. If others may have missed it is maybe because we are not used to teaching with the usage of computers.* *-Nothing; I did not miss anything; everything was clear (most common responses)*

4.3.5 Learners' interview summary

Under this section, this study learnt that learners were delighted to be taught with digital technologies and hoped that it could be a normal practice. Learners however showed that the

subject is not normally taught with the use of technology and they only came across it during this study. This could have led to the challenges experienced by learners during the presentations. The challenges, such as missing some parts of the discussions since the teacher was fast, and not doing more examples and discussions, also led to some learners losing focus during presentations. The study however learnt that most of the learners were able to catch up with the presentations and understood everything. Figure 4.7 below shows an overall summary of the outcomes of learners' interviews. The emerging factors show that more needs to be done to integrate technology in teaching and learning.

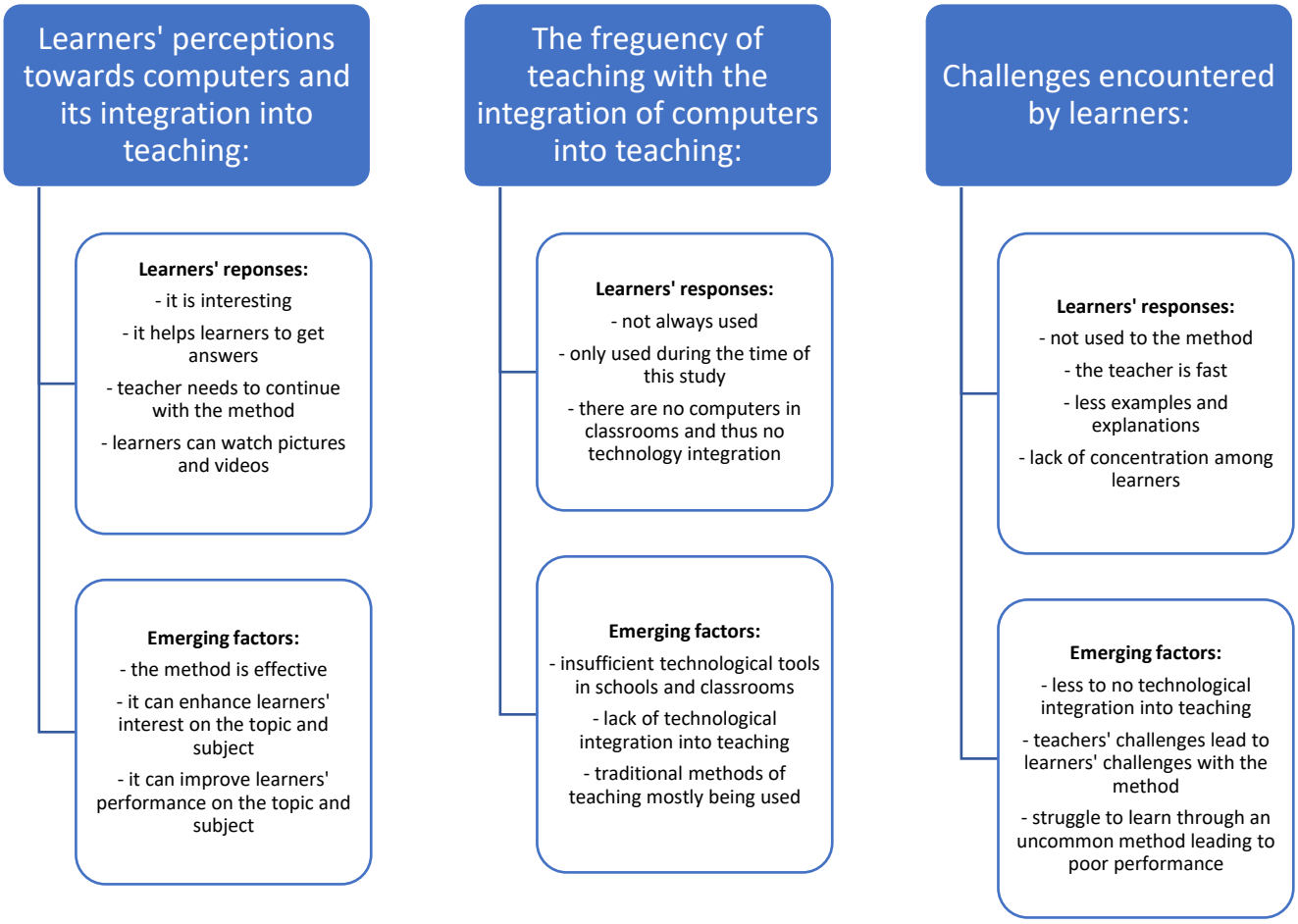


Figure 4.7: Summary of learners' responses and the emerging factors from their responses

4.4 Teacher observations

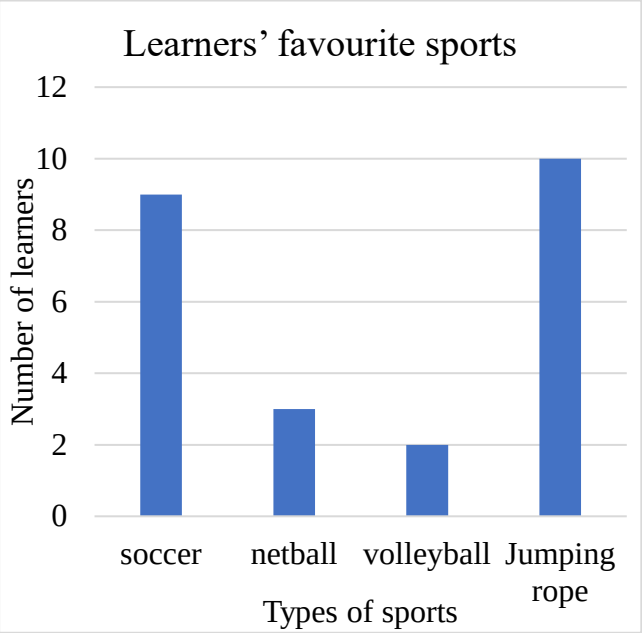
Teachers were observed based on the three types of knowledge of the TPACK theory, namely, Technological Knowledge, Pedagogical Knowledge, and Content Knowledge.

As indicated in section 3.6.2 under observations, these aspects were observed during the observations. This study sought to reveal the challenges that teachers are faced with by observing these aspects: (1) how well the classrooms are equipped with digital resources; (2) teachers' knowledge on technology integration into teaching; (3) knowledge of technology as a teaching method; (4) teachers' content knowledge in relation to technology; and (5) how the knowledge aspects influence each other in teaching and learning. Each aspect is discussed depending on the observation done in the observation checklist (see Appendix G). The researcher recorded the lessons presented by the teachers without interfering with the process by observing and recording while noting down comments on the observation checklist. The recordings were then studied after each presentation for meaning and understanding for better analysis. Some of the PowerPoint presentations were also shared with me and are presented in Table 4.7 below. The table only shows some parts of the presentations from each teacher participant. Later the observations are discussed under each aspect.

Table 4.7: content slides of teachers' PowerPoint presentations

PowerPoint Content slides	Teacher competency and skills
• Collect Data Learners' favourite sports: soccer 9, netball 3, volleyball 2, jumping rope 10 • Organising data (using a tally table and tally marks)	Teacher A Collecting and organising data

Types of sports	Tally marks	Total
Soccer	~~///~~ ////	9
Netball	///	3
Volleyball	//	2
Jumping rope	~~///~~ ~~///~~	10



Teacher A

Representing data on a bar graph

Example: Bar graph

- The height of each bar represents the frequency
- Space between bars must be equal
- Width of the bars must be the same
- Each axis must have a scale
- Each axis must be labelled

What is data

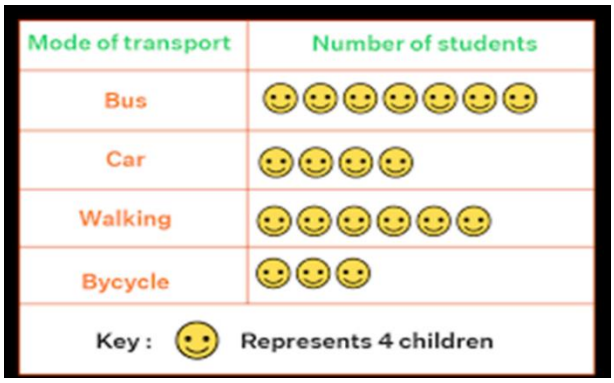
- This is the collection of information from various sources of information.
- We collect information by using questionnaires, census, school statistics, class registers, counting the church attenders etc.

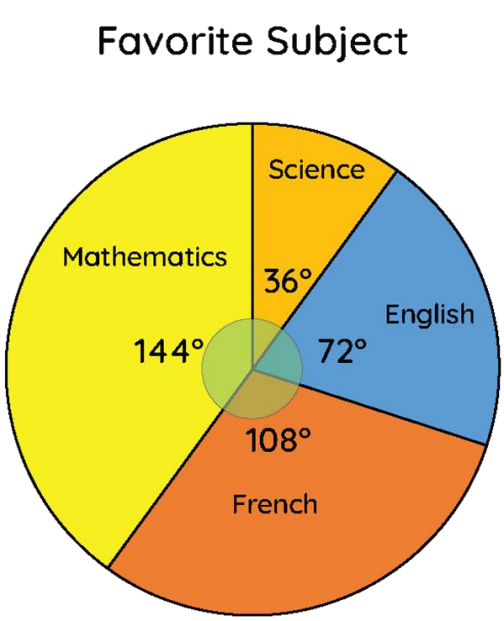
Once we collect our data, we then present them in different forms, such as:

Teacher B

Topic: Data handling

Collecting, Organising, Record and Represent data

a) Pictogram (shows information using pictures/ symbols) b) Tally Sheet c) Pie chart (a circle divided in parts to show each group of data d) Bar graph (vertical/horizontal graph with bars) e) Broken line graph (information presented in lines. Pictograms:  	
Pie Chart	Teacher B 1. Which subject has the lowest degrees? 2. What is the sum of Mathematics and Science? 3. How many degrees are all together? 4. Which is the most liked subject?



Mode is the most appearing value in the data set (the most appearing number)

Example: 5, 9, 4, 20, 14, 5, 6 Mode = 5

Test yourself:

Find the mode of 3 9 6 3 2 4 3 4 3 5 3

Median is the middle value in a list ordered from smallest to biggest.

Example 1: 4, 5, 5, 6, 9, 14, 20 Median = 6

Example 2: (In case two numbers are in the middle) 1, 2, 3, 4 Median = 2+3 = 5/2 = 2.5

Teacher B

Calculating mean, mode and median

Test yourself: a) Find the median of 1 9 3 7 4 6 5 2 8 b) Find the median of 6 8 7 3 5 1 • Mean is the average number; found by adding all data values and dividing by the number of values. Example: Find the mean of 4, 5, 5, 6, 9, 14, 20 $\text{mean} = \frac{4+5+5+6+9+14+20}{7} = 9$ Test yourself: 1. Here are the ages of Grade 7 learners: Marie 11, Paulus 17, Shipiki 19, Nill 13, Rwanda 14 a) Find the mean of their ages 2. Find the average 5, 7, 2, 8, 9, 5	

4.4.1 How well the classrooms are equipped with digital resources

It was observed that the *classrooms at both participating schools were not equipped with technological tools* but rather only the computer lab which the teachers then used to make these presentations. This is a reflection that teachers are not incorporating digital technology into teaching daily because of the *absence of equipment in schools*. The teachers had to make

arrangements with the IC teacher to make use of the computer lab specifically for this exercise and not as a normal practice. The computer lab however is well-equipped with technological tools. It was observed that the computer lab is appropriate for digitalised presentations, there is a computer as well as a projector for presentations. The classes used at both schools are however not the normal Grade 7 classrooms but rather the computer labs that the whole school makes use of for IC lessons.

4.4.2 Teachers' knowledge on technology integration in teaching

Teachers demonstrated fair knowledge on this aspect. The teachers presented pre-prepared lesson presentations on PowerPoint which reflected that they had adequate technological knowledge and that it should be in their daily practices. It was observed that teachers designed a PowerPoint presentation to help them deliver the lesson. The presentation carried the necessary content; which was well-organised and covered the necessary components of the lesson. However, the use of one face (emoji) by Teacher B was limited the number of students for each category to the multiples of 4. At some point, the categories that would carry odd numbers were ruled out. Additionally, *most of the examples and explanations were pre-prepared and not fully demonstrated* during the presentation. Both teachers *struggled with exercising examples on the computer* that are not pre-prepared. Teachers were able to *operate the computer with some difficulties and presented at a slower pace due to their limited knowledge*. This was observed because, at some point, the lessons came to an end when the teacher was still busy teaching.

4.4.3 Knowledge of technology as a pedagogical method

It was observed that teachers demonstrated a fair understanding of technology as a pedagogical method. The displays were informative and carried the necessary content such as graphs, charts

and calculations. *More close-ended questions were used.* If the learner's response was wrong, then another learner gave a response. It showed that the *presentations were more of a teacher-centred pedagogy*. The pre-prepared lesson presentations showed that teachers understood graphics and were creative by presenting good content on the topics. They have shown how to represent data with the use of gadgets positively. It was however observed that *teachers tried to do more of the examples on the chalkboard instead of using the digital tools,* especially when doing calculations. *Learner-centred pedagogy was also minimal* because, even though some group discussions were engaged, they were limited.

4.4.4 Teachers' content knowledge in relation to technology

Under this aspect, the observations focused on the content knowledge of teachers and how they related it to technology while teaching. Teachers' content knowledge was based on collecting, representing, summarising and reporting data, extracting and interpreting data from tables, graphs, charts and pictograms, as well as finding the mean, mode and median of a set of data. Relating content to technology, teachers used different means of showing the content to learners, such as making use of digital tools.

The presentations of teachers under this aspect were rated as good. Teachers demonstrated that they were well acquainted with the content of the topic and reflected the expertise of all sections of the topic. They demonstrated that they understood all the competencies of the topic and were able to show learners how to deal with the competencies. Teachers knew how to collect data, the types of methods used in data collection, how to present, analyse and interpret data in different forms and how to find the median, mean and mode in a set of data. The presentations were technology related, since the teachers utilised the computer and a projector to present the content which included typed notes, pictures and sometimes videos. This, however, did not

prevent teachers from *making use of chalkboards for some discussions*.

4.4.5 How the knowledge aspects influence each other in teachers' presentations

The aspects of knowledge need to work together for effective digitalised teaching and learning process to take place. The observations showed that teachers' presentations integrated all aspects fairly. Teachers' adequate knowledge of technology enabled them to plan digitalised lessons that they presented, as observed. The observations showed that teachers acknowledged technology as a pedagogical method and demonstrated that they were able to use it in teaching. The observations also showed that teaching and learning was positively influenced by the utilisation of digital tools. Learners demonstrated their interest and excitement in the presentations. Lastly, the overall presentations demonstrated how technology is beneficial to effective teaching and learning.

4.4.6 Observations Summary

Both participating schools lacked technological tools in classrooms, limiting teachers' daily incorporation of digital technology. Teachers used computer labs for presentations, requiring arrangements with IC teachers. The labs are equipped with computers and projectors, but not the Grade 7 classrooms. The classes are used for IC lessons and not as regular classrooms. Teachers demonstrated fair knowledge in technology, presenting pre-prepared PowerPoint lessons. However, they struggled with unprepared examples and presented at a slower pace due to limited knowledge. Both teachers struggled with doing exercise examples on the computer and instead did them on the chalkboard or on the flipchart. So, they could improve their presentation skills if they had always taught with use of digital tools.

Teachers demonstrated a fair understanding of technology as a pedagogical method, using informative presentations with graphs, charts, and calculations. They engaged learners through

close-ended questions, demonstrating a teacher-centred approach. Pre-prepared lesson presentations showed creativity in graphics and data representation. However, they often used chalkboard examples instead of digital tools, especially for calculations. Learner-centeredness was minimal, with limited group discussions. The observations focused on teachers' content knowledge and their connection to technology in teaching. Teachers are skilled in data collection, representation, summarisation, reporting, and interpretation. They used digital tools for presentations and demonstrated an understanding of competencies. Teachers' presentations were rated as good, demonstrating their expertise in data collection, methods, presentation, analysis, and interpretation. They used computers and projectors for content presentations, including typed notes, pictures, and videos, while still using chalkboards for discussions.

Lastly, teachers' presentations effectively integrated all aspects of knowledge for effective digital teaching and learning. They acknowledged technology as a pedagogical method and used it fairly. The use of digital tools positively influenced teaching and learning, and learners showed interest and excitement in the presentations. See Figure 4.8 below.

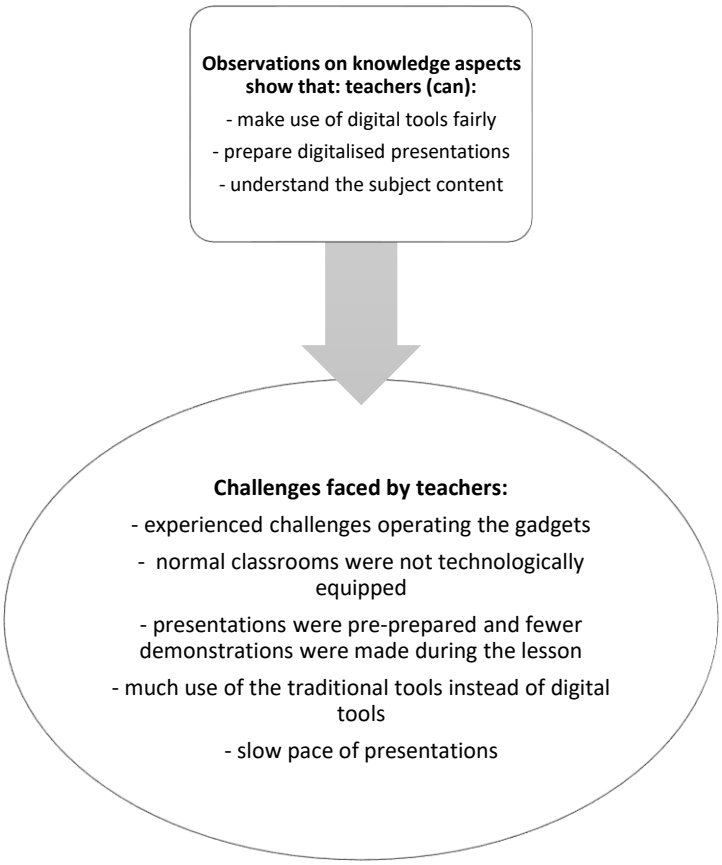


Figure 4.8: Observation summary of the knowledge aspects

Should the teacher have excluded any of the components, this may have led to poor lesson delivery and performance among learners. The three components reflect that the teacher can smoothen the teaching and learning process.

4.5 Triangulation of data (interviews and observations)

The data results discussed in this chapter were based on the responses to the questions that the teachers and learners were asked through semi-structured interviews and the observations done by the researcher while teacher participants were teaching the topic of data handling. This section highlights the triangulated analysis of the results as derived from the data.

The findings on the challenges faced by teachers on the integration of technologies into

teaching were reflected by teachers and learners as well as observations. The findings show that there is a lack of technological equipment at schools to teach digitalised lessons. Teachers, learners, and the researcher's observations attested to this finding as discussed in the previous sections. The findings further showed that teachers were not well equipped with the skills to deliver continuous and effective digitalised lessons thus sometimes learners missed some aspects of the presentations. Through teachers' interviews, this study further found that the inadequate training on digital resources utilisation among teachers also contributed to the challenges of teaching the topic with this method.

From the perspectives of the participants on the use of digital resources to teach the topic, all the participants expressed a positive attitude towards the gadgets. Teachers indicated how they positively impacted the performance of learners and improved their teaching. Learners welcomed the method saying it pleased them to be taught in that way and they wished that it continued. The observations also showed that, should teaching with digital interventions be done efficiently, the integration of digital resources into teaching can be beneficial to both teachers, in terms of making their lessons easier to deliver, as well as to learners who found the contents of the topics easier to understand.

Teachers indicated several ways of incorporating digital resources into teaching, ranging from downloading content, such as videos and pictures, preparing PowerPoint presentations and using the computer and projector to present their lessons. Learners attested that they had been taught with a computer and a projector and they can make use of the computers to search for information. The researcher observed how teachers utilised digital resources to present their lessons. It is therefore evident that digital resources are and can be useful in teaching not only the topic under study but also other subjects.

Finally, the findings indicated how the integration of digital technologies enhance learning. The teachers expressed that digital technologies promote cooperation among learners and accommodate learners with diverse ways of learning. They indicated that learners could learn by seeing, with fewer explanations, and how both the fast and slow learners embrace the method. Learners themselves reflected on how they were able to keep up with the discussions and indicated that they were interested and were able to capture all the contents of the presentations. This shows that technology integration can enhance learners' performances. Figure 4.9 below shows an overview of the triangulation of interviews and observations.

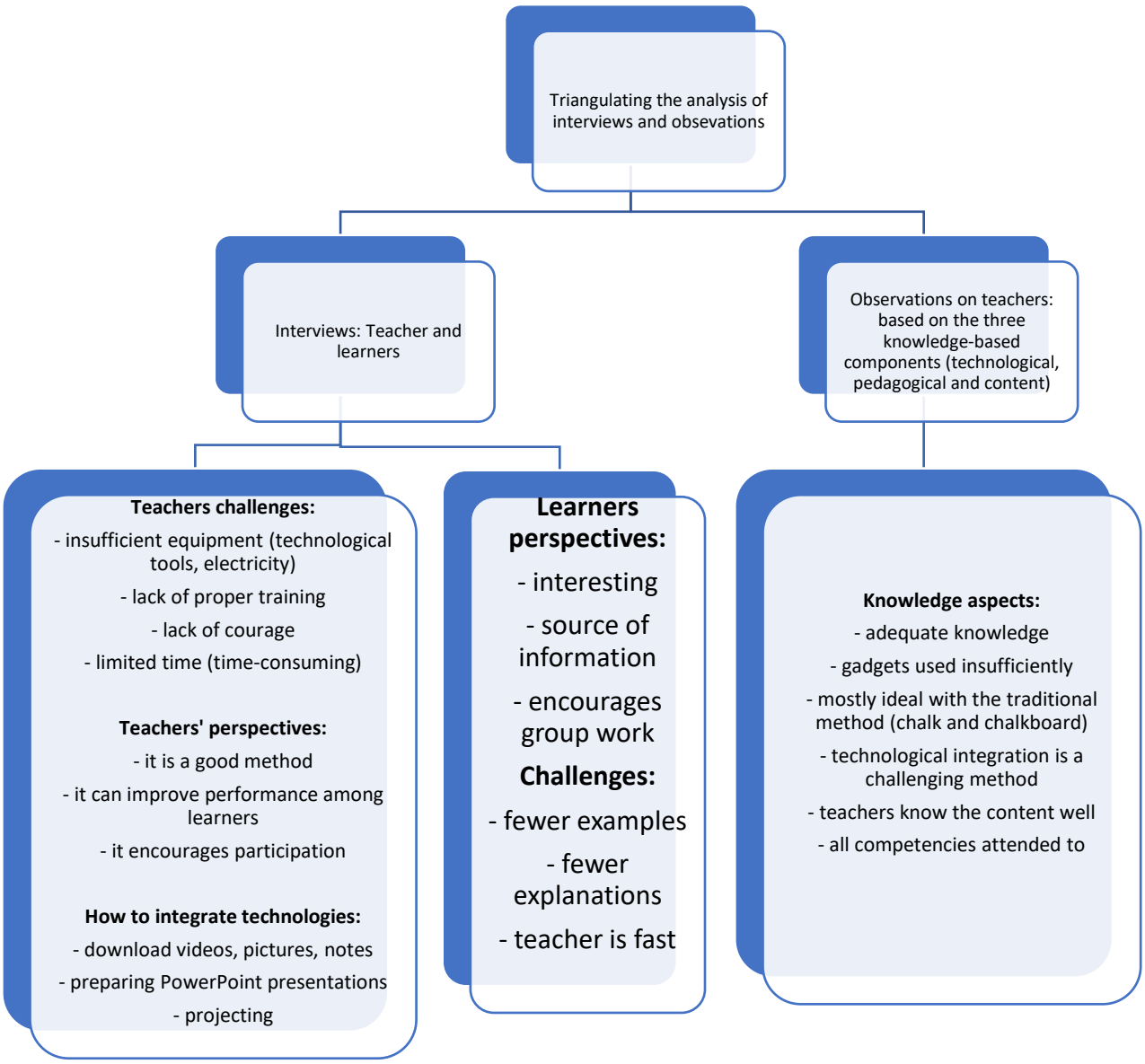


Figure 4.9: Triangulation of the findings of interviews and observations

4.6 Chapter Summary

Under this topic, the researcher analysed the data from two teachers and 26 learners as participants. The chapter analysed the interviews and observations to draw up the themes. The analysis shows that teachers are faced with several challenges when it comes to the integration of digital technologies into teaching. It further shows that the method can become effective should these challenges be attended to. Participants reflected on how integrating technologies

into teaching is a method that can improve learners' performance in Mathematics as a subject and data handling as a topic. The researcher also observed how teachers struggled with the use of technological gadgets but this could be improved. The next chapter presents the interpretation of the data, discussion of results, recommendations, and conclusions to the study.

Chapter 5
Discussion of results, conclusion, and recommendations

5.1 Introduction

The aim of this study was to explore the challenges faced by Grade 7 teachers to integrate digital technologies in teaching data handling. The study also sought to investigate how teachers perceive the integration of technologies in teaching; how the teachers incorporate digital technologies in teaching data handling; and how the integration of digital technologies could enhance learning. To achieve the aim of the study, the question on the challenges experienced by Grade 7 Mathematics teachers to integrate digital technologies in teaching data handling was asked as the main question of the study. Concurrently, the perspectives of teachers on the integration of digital technologies in teaching, how teachers integrate technologies in teaching, and whether digital technology integration in teaching could enhance learning, were asked as sub-questions of the study.

To answer all the questions and achieve the aims and objectives of the study, this study reviewed the literature on previous studies that are related to the current study. The questions and aims of the study were then integrated in semi-structured interviews that were conducted with Grade 7 Mathematics teachers and observations done as the teachers taught the topic under investigation, that is, data handling. To enrich the outcomes of the study, the Grade 7 learners from the participating schools, who are being taught the topic of data handling, were interviewed to help the researcher gain rich data that could help the researcher achieve the aims and answer the research questions of the study. Chapter 5 discusses the findings of this study, the conclusions, and then the recommendations of the study. Based on the findings, the current study was able to make conclusions from the outcomes and make recommendations from the findings. This chapter also presents the limitations encountered in the study.

The findings discussed are based on the research questions and aims and goals of the study as presented in the introduction to the chapter. While analysing the data, ten themes were generated under teachers' interviews, three themes emanated from learners' interviews and three components of the theoretical framework were used to collect data from the classroom observations. All the themes and components are presented in the previous chapter. The themes were grouped according to the questions they addressed. The main question of the study had themes 1, 3, 4, 5, 7 and 9 from the teachers' interviews, themes 3 and 4 from learners' interviews and aspects 1 and 2 from the observations. The themes from teachers' interviews were: (1) teachers' technological skills and teaching experience in Mathematics; (3) training on teaching Mathematics with the use of digital tools; (4) technology versus traditional methods; (5) challenges of technology integration with teaching; (7) availability of digital tools at schools; and (9) technology integration for learning. The themes from learner's interviews were: (3) how technology could enhance learning through group discussions; and (4) the challenges that learners met while being taught with the use of a computer. The aspects from observations were: (1) how well the classrooms were equipped with digital resources; and (2) teachers' knowledge on technology integration into teaching. However, some themes, such as theme 7 under teachers' interviews, was also able to answer sub-question 2 of the study alongside part 3, and theme 4 was able to supply answers to sub-question 1. Theme 6 from teachers' interviews and theme 1 from learners' interviews were able to answer sub-question 1. The themes were: (6) perceptions of technology integration with teaching; and (1) learners' perspectives on computer integration in teaching and learning. Theme (8) the curriculum and technology integration in teaching, under teachers' interviews and theme (2) the frequency of computer integration in teaching and learning from the learners' interviews alongside aspects (4) teachers' content knowledge in relation to technology as well as (5) how the knowledge aspects influence each other in teachers in teaching and learning were used to answer sub-

question 3 of the study.

5.2 Answering the research questions

5.1.1 Sub-question 1: *What are the perspectives of the Grade 7 Mathematics teachers on the use of digital resources in teaching data handling?*

Digital technology integration in teaching plays a vital role in learners' academic achievement when teachers are well acquainted with the method (Akturk & Ozturk, 2019). Yet, the findings of this study show that teachers have different feelings towards the method. Figure 4.2 shows that teachers did not fully utilise the digital tools to present the lesson but rather switched to the chalkboard that they are used to using daily. Although teachers acknowledged that the integration of digital technologies in teaching can enhance the teaching and learning process (Merillo & Domingo, 2019) and subsequently the performance of learners in data handling and Mathematics, and encourage participation and group work among learners, they still had mixed perspectives towards it. In addition to the existing challenges, teachers felt attached to the traditional methods and found them preferable to modern teaching methods, that is, digital integration.

Beside the integration of digital resources in teaching and learning being time consuming, the participants further emphasised the lack of technological tools in all schools and classrooms, and that some schools do not have electricity to run the tools (see Figure 4.4). Furthermore, the findings show that teachers perceived the use of digital tools to teach to be challenging due to their limited knowledge of the gadgets, and instead preferred the traditional methods, which they are used to. Technological integration in teaching as a pedagogical method needs to be mastered before it can be utilised in the classroom in their presentations. However, the findings of the study show that teachers' technological knowledge was limited, and this gives teachers

negative perceptions towards the method. Studies also show that the degree of integration of digital technology in the classroom seems to be connected to teachers' TPACK developmental stage and that teachers with a more developed TPACK are likely to use digital resources more effectively in their teaching practices (Loong & Herbert, 2018).

Learners were also given an opportunity to reflect on how they perceived the use of computers in teaching and learning. Every learner's response was that it was interesting. Learners confirmed that computers help learners to get answers to activities and they can watch educational videos and pictures, such as graphs. As shown in Table 4.3, learners expressed their satisfaction towards the utilisation of the tools in teaching, with all of them having given positive responses. Learners indicated that the method helped them to understand the topic better and they would like the teacher to continue teaching with the use of the gadgets. Mukhari (2016) indicates that technological integration in teaching helps to develop learners' elevated level of thinking to solve problems with ease.

5.1.2 Sub-question 2: *How do teachers incorporate digital technology in teaching data handling?*

Data handling has been rated as one of the underperformed topics in Grade 7 Mathematics in Namibia. Yet few studies have been done in the country on improving the performance of the topic. However, this study perceives that, when it is correctly integrated, digital technology can improve the performance of data handling in Grade 7.

This study observed that the schools are not adequately equipped with technological equipment, because only computer labs were equipped. Normal classrooms are not equipped with any digital tools and teachers have no alternative other than using traditional methods of teaching. Learners' responses in Table 4.4 show that the integration of technologies in schools

in teaching is relatively low. Learners indicated that they had never been taught Mathematics lessons or any other subjects with the use of a computer and overhead projector except for the IC lessons and that they were being taught with gadgets in Mathematics for the first time. Teachers were observed printing activities for presentations. Classrooms were not equipped with technological equipment, hence the participants had to plan with the IC teachers to make use of the Computer Lab to teach during the exercise of this study. This is a clear indication that, under normal circumstances, teachers make use of the normal classrooms that are not equipped with technological resources for teaching and thus there is no integration of technologies in teaching.

This study found that the integration of digital technologies in schools is very minimal. It was further established that, during the teaching and learning of data handling in Grade 7, teachers normally made use of chalkboard and textbooks and not digital tools. During the exercise of this study, teacher participants planned to make use of the computer lab. However, teachers struggled with the digital tools and sometimes reverted to the old ways of teaching. Teachers prepared their presentations on PowerPoint and displayed them on the projector. Teachers then did the presentation mostly by reading from the projector displays and discussing it with learners.

The results further show that teaching digitally is not a normal practice but was only done for this study. Learners' responses indicated that they were being taught in that way for the first time and that there were no computers in their normal classrooms, thus no technological integration was taking place.

5.1.3 Sub-question 3: *How does the integration of digital technology in teaching data handling enhance learning?*

The participants in this study indicated that the integration of digital technology would enhance learning as it allows learners to work together. Omoso and Odindo (2020) also emphasise that technological integration in teaching can revolutionise teaching and learning if skilfully integrated in teaching. Leach et al. (2005) further suggest that it promotes learner-centred pedagogy. Research has richly outlined that learner-centred pedagogy is a teaching approach that emphasises the student's active participation in the learning process. It contrasts with traditional teacher-centred methods, where the teacher is the primary source of knowledge and authority. In learner-centred education, students are encouraged to take responsibility for their own learning, which can lead to several enhancements in the learning experience (Caroline, 2023; Parrish, 2022). Studies further show that learner-centred teaching and learning encourages students to explore and question, and fosters critical thinking skills. It increases engagement, and when students are involved in setting their learning goals and have a say in how they learn, they are more likely to be engaged and motivated. Learner-centred also prepares learners for real-world challenges. It often involves real-world problem-solving, preparing learners for the complexities of life beyond the classroom (Caroline, 2023).

The study further established that integrating digital technologies in teaching and learning could develop learners' interest in the topic as well as the subject, and thus improve the passing rate on the topic. Learners' responses, as summarised in Table 4.6, also show that learners perceived the method as interesting and that it stimulated engagement among learners. The method was also said to encourage participation among learners. In Figure 4.7, the summary also shows that the method is effective and boosts learners' interest in the topic and the subject.

5.1.4 Evaluating the objectives of the study

Themes that emerged from data analysis were applied in confirming that the objectives of the study were achieved. The objectives of the study were to explore how teachers perceived the integration of digital technologies, investigate how teachers incorporated digital technology in teaching data handling and to probe how the integration of digital technology could enhance learning.

5.1.4.1 How teachers perceive the use of digital resources in teaching data handling

The integration of digital technology in teaching and learning is perceived to be modern way to successfully deliver sound and effective lesson presentations in comparison to the old ways of teaching. It is also considered to be learner-centred and makes learners understand the content better by putting them at the centre of the discussions. Literature has revealed that technology integration teaches in a problem-based method, which meets the interests and requirements of learners (Namitha, 2018). It is further emphasised that, since ICT is learner-centric, it encourages students to actively take part in the learning process. When learning activities are engaging, real, multisensory, and cross-disciplinary, students become more motivated. ICT initiatives and programmes have been shown to increase student motivation, attendance, academic success, and effective communication in schools (Elets Digital Learning, 2020).

During the analysis of data, the participants indicated that the integration of digital technology in teaching exposes learners to many ways of learning and captures learners' attention during the lessons. The participants further indicated that technology tools give the teacher opportunities to effectively deliver the content with fewer explanations and provide learners with more activities. Teachers however, still perceived the method to be ineffective since it can

also be disruptive as learners' attention is given to the tools rather than the lesson. Hence, the method has been differently perceived in terms of its integration in teaching.

5.1.4.2 How teachers incorporate digital technology on teaching data handling

The integration of technology in teaching requires the presence of digital tools that are fully functional in the classroom where the teacher can use them in the teaching and learning process. However, literature has shown that there is limited scope on the integration of technology in teaching and learning in Namibian classrooms. This is either as result of insufficient tools in schools, negative perceptions of the method from teachers or inadequate knowledge on how to utilise the method to deliver digital lessons successfully. Literature also notes that teachers can make use of computer hardware and software, such as PowerPoint and overhead projectors, in teaching as a form of digital technology (Barroso, 2019; Rofi'I & Nurhidayat, 2020; Hashemi et al., 2012; Alkamel & Chouthaiwale, 2018). The analysis of the data also shows that the incorporation of digital technology in teaching is a challenge for teachers because of the issues raised in the literature review. The teachers expressed that schools were not well equipped with digital tools that are necessary for the integration of technology in their classrooms. Participants further indicted that there were negative perceptions towards technologies and thus integration in teaching is inadequate. The participants however, indicated that the use of computers and projectors to show learners videos, images and do PowerPoint presentations are among the digital tools that are useful in the incorporation of digital technologies in the teaching and learning of the topic.

5.1.4.3 How the integration of digital technology could enhance learning Data handling

The integration of digital technology in teaching and learning has been proven to have a positive impact on learners' learning outcomes, improve learners' performance, increase

motivation and change attitudes towards Mathematics (Atun & Usta, 2019; Hernawati, 2019). It is further reported that the integration of technology in teaching develops learners' high thinking capacity levels so that they can solve problems with ease. These arguments show how the method is helpful in improving and enhancing learners' performance. The analysis of data also shows that both teachers' responses attested to the fact that technology integration increases learners' motivation and interest in the topic and improves their performance. The participants indicated that the method could improve learners' performance because they learn visually. The respondents further showed that it would also help learners to be more engaged throughout the presentations as they would collect their information, organise it and interpret it, thus giving them a chance to improve and to be able to remember this during activities such as tests and examinations.

5.3 Challenges that Grade 7 Mathematics teachers face in integrating digital technologies in teaching

The research uncovers a complex range of obstacles that Grade 7 Mathematics teachers face when attempting to incorporate digital technologies into their data handling instruction. These challenges are not new; they echo previous reports in the field. Teachers grapple with a lack of technological resources within educational institutions, perceive digital methods as overly time-intensive, and often lack adequate training, which results in a deficiency of necessary technological skills. Furthermore, the curriculum itself does not seem to be optimally structured to support the integration of technology into the teaching process.

The study's findings suggest that while teachers possess some level of technological proficiency, as depicted in Figure 4.1, they still confront numerous impediments that prevent the effective adoption of digital technologies in their teaching practices. Prior research by Simataa (2015) corroborates the scarcity of technological equipment in schools, which poses a

significant barrier to technology integration. Section 4.2.2 of the preceding chapter reveals teachers' open views on the time-consuming nature of digital methods, their complexity in application during examples, and the difficulties in explaining content to students.

Moreover, the study identifies a lack of technological skill among teachers, stemming from insufficient pre-service and in-service training, as highlighted by a participant's remarks in section 4.2.3 regarding the absence of expertise and experience in utilizing digital tools. The study also notes the inadequate provision of digital equipment in schools and classrooms, teachers' hesitancy to use the limited resources available, the time consumed in integrating digital technologies, a preference for traditional teaching methods, challenges in managing classrooms during technology integration, a curriculum that does not fully embrace technology, and teachers' ambivalent attitudes towards the adoption of digital technologies in education.

In section 4.2.4, the study further explores the teachers' comfort with conventional teaching methods and their subsequent struggle to adapt to technological integration. This is visually represented in Figure 4.4, which illustrates the predominance of traditional teaching over the use of technology. The lack of continuous professional development (CPD) in schools, particularly concerning digitalised lessons, is another significant issue. The study cites Akturk and Ozturk (2019) and Bingimlas (2018), who advocate for the provision of in-service training to bolster teachers' technological capabilities. Simon and Ngololo (2015) confirm that only a minority of teachers implement ICT in their classrooms without professional training and advanced equipment. This disparity in technological integration in teaching Mathematics is further exemplified by the varied experiences of teachers, with one having nine years of experience and another only two in teaching the subject, yet neither has received training in this critical area.

The research delves into the significant issue of technological scarcity in schools, a challenge acutely felt in rural areas of Namibia. The study illustrates, through Figure 4.5, the various factors that teachers identify as barriers to integrating technology into their teaching practices. This shortfall has compelled educators to rely on conventional teaching tools such as chalkboards, chalk, and textbooks. Despite the Ministry of Education's efforts through the Education and Training Sector for Improvement Programmes (ETSIP) to elevate educational standards between 2006 and 2011, aligning with Vision 2030, the mid-term assessment in 2011 revealed that these initiatives were not as effective as anticipated, highlighting the persistent gap in technological resources within schools.

Moreover, the study sheds light on the difficulties students encounter with digitalised lesson presentations. It suggests that the challenges teachers face in delivering these lessons often translate into inadequate learning experiences for students. The learners reported that digitalised lessons tend to offer limited explanations and examples, and they felt that the pace of teaching was too rapid for them to grasp the material effectively. This indicates a need for a more thoughtful approach to the implementation of digital technologies in education, ensuring that both teachers and students are equipped to succeed in a digitalised learning environment.

5.4 Conclusions

The study's findings offer a comprehensive look at the challenges Grade 7 teachers face in integrating digital technologies into data handling lessons. Teachers struggle with a lack of digital tools, inadequate skills, and insufficient training, which hinders their ability to effectively use digital tools in teaching. This reluctance is compounded by the time-consuming nature of digital methods and some teachers' negative attitudes towards technology, likely stemming from a lack of familiarity and confidence in using these tools.

Despite these hurdles, there is a general enthusiasm for digital learning. Teachers and students are keen to embrace technology-enhanced education, recognizing its potential to prepare students for a competitive job market. The study underscores the global appreciation for digital classrooms and the transformative impact they can have on education.

However, the reality in schools is that digital technology integration is minimal, often limited to specific topics and overshadowed by traditional chalkboard teaching. This is partly due to infrastructural constraints, such as the absence of electricity and computers, which are primarily used for administrative tasks. The study points out the government's slow progress in providing necessary digital equipment to schools, which is essential for broader integration.

In terms of enhancing learning, the study concludes that with proper attention to digital integration and teacher training, technological tools can significantly improve educational outcomes. It cites Ghavifekr and Rosdy (2015), who emphasize the importance of professional development programs in elevating the quality of learning. When teachers are well-equipped with digital tools and knowledge, they can deliver successful technology-based instruction, leading to better learning experiences for students.

5.5 Implications of the findings

The insights from Chapter 2, which encompass theoretical viewpoints and prior research, set the stage for the empirical findings of Chapter 5. The Technological Pedagogical Content Knowledge (TPACK) model is pivotal and contributed in explaining how teachers' proficiency in this framework could elevate students' performance through skilful technology use. Nonetheless, the issues pinpointed in Chapter 5, such as the scarcity of resources and inadequate training, signal a disconnect between theoretical aspirations and tangible experiences.

While Information and Communication Technology (ICT) is lauded for its potential to boost student engagement and achievement, as per Chapter 2, the actual feedback from learners on technology-assisted instruction in Chapter 5 suggests that these benefits are not being fully tapped. The recurring theme of obstacles in Chapter 5 underscores that the practical application of digital tools in education is falling short of expectations.

The comparison of these chapters reveals that despite a solid theoretical endorsement for digital technology's role in education, its real-world enactment faces significant barriers in Namibia. Overcoming these hurdles could serve as a catalyst for reconciling theoretical ideals with classroom realities, thereby enhancing educational results. This synthesis not only reaffirms the value of a theoretical foundation for guiding scholarly inquiries but also casts light on the urgent need for actionable strategies to overcome the difficulties encountered by educators. It emphasizes the criticality of harmonizing pedagogical methods with academic theories to realize the full potential of technology in education.

In essence, the literature review conducted in this study underscores the significance of digital technology in the pedagogy of data handling and delineates the challenges educators grapple within its integration. The literature facilitated a comprehensive discussion on the utilisation of digital tools as instructional aids and the role of technology in teaching and learning. The TPACK theory, serving as the theoretical compass for the study, informed the literature search and provided a framework for understanding the subject matter. The chosen methodology guided the data gathering and analytical procedures, ultimately steering the study towards fulfilling its objectives, answering the research questions, and formulating conclusions and recommendations.

5.6 Recommendations

The study underscores the necessity for further investigation into the obstacles that educators encounter when incorporating digital technologies into data handling instruction. It advocates for additional research to underscore the significance of such integration. A key recommendation is the provision of ample technological resources directly within classrooms, not confined to computer labs, to facilitate a seamless and effective adoption of digital technologies in education. The onus is on the government, which has already endorsed ICT policies, to equip schools accordingly. Nonetheless, schools should also proactively seek support from private and public entities, including NGOs.

To bolster the technological proficiency of educators, comprehensive training for both pre-service and in-service teachers is essential. The curriculum requires immediate revision to address current shortcomings that impede the successful integration of technology in instruction. Although the curriculum nominally supports ICT integration, it lacks clear guidance on implementation. Curriculum developers should be encouraged to supply digitally-oriented materials to aid in this transition.

Continued Professional Development (CPD) is crucial for teachers to stay abreast of technological advancements, fostering a willingness to integrate technology into their teaching practices. Teachers have expressed a need for enhanced skills in technology integration, not only for data handling but across the mathematics curriculum. Educational institutions must expand their offerings to equip new teachers with the necessary technological skills for their professional roles.

Furthermore, there is a lack of literature about technology integration within the specific context of Namibian education, particularly concerning mathematics topics at the senior

primary level. The study calls for more extensive research in this area, suggesting that additional funding be allocated to students aiming to master digital technologies for teaching and learning mathematics at this level. Research could also explore the use of digital tools for practical activities and projects within the mathematics curriculum.

In summary, the study presents a comprehensive set of recommendations for the integration of digital technologies in education, particularly for Grade 7 teachers in Namibia teaching data handling. These include:

- Developing a robust technological infrastructure in schools.

- Implementing ongoing professional development for teachers.

- Revising educational policies and curriculum in line with the TPACK framework.

- Ensuring equitable distribution of digital resources.

- Engaging the community and parents in digital literacy initiatives.

- Fostering research partnerships for innovative digital teaching solutions.

- Establishing systems for monitoring and evaluating technology integration efforts.

- Promoting student-centred teaching approaches that leverage technology.

- Cultivating leadership within schools to champion technology integration.

- Designing sustainable and scalable technology integration initiatives.

5.7 Study limitations

This study ought to be carried out in one circuit that is using the same scheme of work in

teaching Mathematics within the same term. This is likely to lead to the researcher and the participants planning so that the lessons on the topic are prepared for afternoon classes instead of the normal morning classes.

This study was conducted in two schools in Otunganga Circuit, Ohangwena Region in Namibia where it only targeted Grade 7 Mathematics teachers and learners. The study was limited to finding out about the challenges faced by the mathematics teachers in integrating digital technologies in teaching data handling in Grade 7, and their perspectives on integrating digital technologies in teaching therefore the findings cannot be generalised to all schools but only to schools with similar characteristics.

5.8 Summary

Chapter 5 examines the difficulties Grade 7 teachers face in incorporating digital technology into data handling lessons. It evaluates their attitudes towards technology, integration techniques, and the effects on learning. The chapter identifies a split in teachers' views, with some favouring traditional teaching despite the recognized advantages of technology. Key challenges include limited technology access, insufficient training, and a curriculum that doesn't support full digital integration, resulting in minimal technology use. The chapter concludes that while there is a keen interest in digital learning, practical application is limited due to various barriers, including infrastructure and adherence to conventional methods. The findings suggest a misalignment between the potential of digital technologies and the actual challenges in education, recommending improvements in technological infrastructure, curriculum updates, and continuous teacher training. The study notes its limitations, including its localized focus and limited applicability of its conclusions. Overall, Chapter 5 provides an in-depth analysis of the integration of digital technologies in education, outlining the obstacles,

conclusions, and recommendations for enhancing future research and teaching practices.

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Appendix A: Research Ethics Clearance Certificate

UNISA university of south africa

UNISA COLLEGE OF EDUCATION ETHICS REVIEW COMMITTEE

Date: 2021/09/08

Ref: **2021/09/08/61942553/18/AM**
Name: Mr JN Paulus
Student No.:61942553

Dear Mr JN Paulus

Decision: Ethics Approval from 2021/09/08 to 2024/09/08

Researcher(s): Name: Mr JN Paulus
E-mail address: 61942553@mylife.unisa.ac.za
Telephone: 0817523424

Supervisor(s): Name: Dr MM Masilo
E-mail address: masilmm@unisa.ac.za
Telephone: 012 429 6154

Title of research:

Exploring the challenges faced by Grade 7 mathematics teachers in integrating digital technologies in teaching Data handling.

Qualification: MEd Mathematics Education

Thank you for the application for research ethics clearance by the UNISA College of Education Ethics Review Committee for the above mentioned research. Ethics approval is granted for the period 2021/09/08 to 2024/09/08.

*The **medium risk** application was reviewed by the Ethics Review Committee on 2021/09/08 in compliance with the UNISA Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment.*

The proposed research may now commence with the provisions that:

1. The researcher will ensure that the research project adheres to the relevant guidelines set out in the Unisa Covid-19 position statement on research ethics attached.
2. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.

University of South Africa
Preller Street, Muckleneuk Ridge, City of Tshwane
PO Box 392 UNISA 0003 South Africa
Telephone: +27 12 429 3111 Facsimile: +27 12 429 4150
www.unisa.ac.za

3. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the UNISA College of Education Ethics Review Committee.
4. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.
5. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing.
6. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
7. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data requires additional ethics clearance.
8. No field work activities may continue after the expiry date **2024/09/08**. Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

Note:

The reference number **2021/09/08/61942553/18/AM** *should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Kind regards,

Prof AT Motlhabane
CHAIRPERSON: CEDU RERC
motlhat@unisa.ac.za

Prof PM Sebate
EXECUTIVE DEAN
Sebatpm@unisa.ac.za

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Appendix B: Permission Letter from the Ohangwena Regional Director

REPUBLIC OF NAMIBIA
OHANGWENA REGIONAL COUNCIL
DIRECTORATE OF EDUCATION, ARTS AND CULTURE

Office of the Director
Tel: (+264) 65 290200
Fax: (+264) 65 290224
Enquiries: Mirjam Nambahu
Email: ndapewa.nambahu@gmail.com
Our Ref: 26/1/9/8

Harelbecke Street, Greenwell Complex Building
Private Bag 88005
EENHANA

27 September 2021

Mr. Johannes N Paulus
PO Box 3718
Ondangwa

SUBJECT: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN OHANGWENA REGION

1. Receipt of your letter dated 12 August 2021 is hereby acknowledged.
2. The request has been evaluated and found to have merit.
3. Kindly be informed that permission to conduct research at Combined School and Combined School in Otunganga Circuit has been granted under the following conditions and requests:
   - The data to be collected only be used for the completion of your studies.
   - You have to liaise with the Principals concerned to make prior arrangements before the date of the research.
   - No other data should be collected other than the data stated in the request.
   - You may share the final report of your study with the directorate.
4. It is trusted that you will find this arrangement in order. In addition, we wish you all the best with your studies.

Yours Sincerely,

Isak Hamatwi 27/09/2021
REGIONAL DIRECTOR

Ohangwena Regional Council
Directorate Of Education Arts and Culture
Office of the Director
27 SEP 2021
Tel: 065-290 200 • Fax: 065-290 224
P/Bag 88005 • Eenhana
REPUBLIC OF NAMIBIA

Appendix C: Letter to School Principals

P O Box 3718

Ondangwa

Namibia

19 January 2022

The School Principal

School A or B

Otunganga Circuit

Ohangwena Region

Dear Sir/Madam

I, Johannes Natangwe Paulus, am a teacher at Uukelo Combined School, Otunganga Circuit, Ohangwena Region. I am researching Mathematics Education towards my Master's Degree at the University of South Africa (UNISA). I am thus writing this letter to ask for permission to conduct my research at the school. This school is among the schools offering Grade 7 Mathematics in the circuit and was purposely selected as it is well equipped with the equipment that could be used to deliver digitalised (computer-assisted) lessons.

The study is under the title: "EXPLORING THE CHALLENGES FACED BY GRADE 7 MATHEMATICS TEACHERS IN INTEGRATING DIGITAL TECHNOLOGIES TO TEACH DATA HANDLING: A CASE STUDY."

The study aims to explore the challenges that Grade 7 Mathematics teachers face when integrating digital technologies into teaching Data handling as a topic in Mathematics and to propose possible solutions that could help teachers to improve their teaching pedagogies through technology integration into teaching and subsequently improve the passing rate of learners, performance in Mathematics as a subject and in Data handling as a topic.

The researcher selected two schools that would undergo the study in which two Grade 7 Mathematics teachers from these schools will participate as participants, should the school principals, learners and their parents, and teachers agree to take part.

The study will entail observations in which the researcher will observe teachers while teaching Data handling in Grade 7 with the use of a computer and an overhead projector as well as interviews to be interviewed to the two teachers.

The researcher will observe the teachers throughout the Data handling topic lessons. I will also interview teachers as one of the data collection instruments. I will provide the teacher and learners with probable interview questions beforehand so that he/she will have enough time for thinking in order to give detailed information about the topic. Each interview will take approximately 30-40 minutes. The benefits of this study are that it will help teachers of Grade 7 Mathematics at schools overcome the challenges of successfully integrating digital

technologies into the teaching and learning process. The findings from this study will be used as a tool to inform all the educational stakeholders about the challenges schools face when exercising the syllabus in terms of computer-assisted presentations.

Participation in the study is voluntary and there will be no reimbursement or any incentives for participation in the research.

A copy of the thesis will be given to each of the schools that will take part in the research and a summary of the findings and recommendations will be discussed with the Mathematics teachers and of the schools that will take part in the research. The thesis will also be available at the library at Ohangwena Regional community library and the Ohangwena Education Directorate. Feedback on the study's final results will also be given on participants' requests. Approval has been granted by the Director of Education for Ohangwena Region and is attached to this letter and the Department of Education & the Ethics Committee of the College of Education, Ethical Clearance Reference number: **2021/09/08/61942553/18/AM**, UNISA. A letter to the participants(teachers) is also attached to this letter. Participants can contact the researcher at +264 81 752 3424 or jpaulus669@gmail.com for feedback.

Thank you for your understanding and I look forward to getting a satisfactory response from your office soon.

Sincerely yours

Johannes N Paulus

(Researcher)

Appendix D: Teacher consent letter

Dear Teacher participant

This letter serves as an invitation to consider your participation in a study.

As a master's student in education, Johannes Natangwe Paulus is conducting a study at the University of South Africa called " EXPLORING THE CHALLENGES FACED BY GRADE 7 MATHEMATICS TEACHERS IN INTEGRATING DIGITAL TECHNOLOGIES TO TEACH DATA HANDLING: A CASE STUDY." The Department of Education, the Ethics Committee of the College of Education, UNISA, and the Director of Education for the Ohangwena Region all give their approval for the study (Ethical Clearance Reference Number: 2021/09/08/61942553/18/AM). I chose your school because it has the equipment necessary for you to access digitalized lesson delivery, which will allow me to collect accurate data for the study. If you would agree to participate in this initiative, I would like to tell you more about it and what your involvement would entail.

The findings of this study are significant because they will help policymakers and pre- and post-teacher training programmes understand the difficulties teachers face when incorporating digital technologies into their instruction of Data handling in Grade 7 Mathematics as well as how doing so might improve students' understanding of the subject. They can therefore think of potential answers to these problems. Teachers will gain from this awareness of the various approaches to enhance their teaching and learning methods.

Should you agree to undergo this study as a participant, the following will happen during the study.

- Interviews

To react to several questions that will be posted to you based on the study topic and questions, the researcher will need to interview you. Data handling as a subject and Grade 7 Mathematics as a subject can both benefit from the utilisation of this knowledge. The duration of the interview will be between 30 and 40 minutes. It will happen at a time and a place that has been mutually agreed upon. If you would prefer, you can choose not to respond to any of the interview questions. I, however, request that you do, to help me acquire data for the study. The interview will be audio-recorded with your agreement to aid in the gathering of correct data, and will then be transcribed for analysis. I will send you a copy of the transcription as soon as it is finished so you may check the correctness of our talk and add or clarify any points.

- Classroom observations

For the length of the study, the researcher would like to watch you teach Grade 7 students in data handling. The researcher will watch you use digital technology to teach the subject and the difficulties that the presentations offer. The researcher is interested in seeing how computer-assisted instruction might help students learn a subject better.

The presentations will be videotaped with your and your students' permission so that the researcher can revisit them even after the presentations. This will enable me to comprehend the presentation and the study more thoroughly as a researcher. Your answers during the interview and any data we gather from our observations will be treated in strict confidence. Your identity won't be included in any publications that come from this research, and the report won't contain any information that may be used to identify you. However, we may utilise anonymous quotes with your consent. The information gathered for this study will be kept in my secured office for five years on a password-protected computer and other devices.

Additionally, there are no penalties if you decide at any point to stop participating in this study. Teachers will be able to use the study's recommendations to strengthen their instruction of Data handling as a topic and as a whole, and learners will greatly benefit from the study's recommendations in terms of increased performance and topic learning.

You have no risks as a participant in this study that are known or anticipated. There are no financial rewards or other incentives for doing so. The results will be available for one to two months after the study is over.

If you have any questions regarding this study or would like additional information to assist you in deciding on participation, please contact me at +264 81 752 3424 or via e-mail at: jpaulus669@gmail.com, or my supervisor Dr MM Masilo at 012 429 6154 or by email at: masilmm@unisa.ac.za.

If you accept my invitation to participate, I request you to sign the consent form. I look forward to speaking to you and thank you in advance for your assistance in this project.

Yours sincerely,

Johannes Natangwe Paulus (Teacher, Uukelo Combined School)

Teacher consent

I, _____ (participant name), confirm that the person requesting my consent to take part in this research has informed me about the nature, procedure, potential benefits and anticipated inconvenience of participation. I have read and understood the study as explained in the information sheet. I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable). I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified. I agree to the recording of the interviews and classroom observation. I have received a signed copy of the informed consent agreement.

Participant name & surname (please print) _____

Participant signature_____ Date: _____

Researcher's Name & Surname (please print) _____

Researcher's signature Date: _____

Appendix E: Parent consent letter

Dear Parent

Your kid is asked to take part in the investigation titled, "EXPLORING THE CHALLENGES FACED BY GRADE 7 MATHEMATICS TEACHERS IN INTEGRATING DIGITAL

TECHNOLOGIES TO TEACH DATA HANDLING: A CASE STUDY." As part of my master's thesis research at the University of South Africa, I am conducting this investigation. The goal of the study is to identify the difficulties instructors have when incorporating technology into their instruction of Data handling in Mathematics in schools and to determine the most effective strategies for assisting them in doing so. The study reveals potential advantages for enhancing teaching and learning to advance learners' learning. The goal is to raise awareness of the obstacles among all parties involved in education and to propose ideas for ways to improve teaching through the incorporation of digital technologies. Therefore, I am asking for your permission to include your child in this research. If you allow your child to participate, he/she will be engaged into:

- Classroom observations and Interviews

The researcher will film your child's lessons as they happen in the classroom and then analyse the footage. You are hereby requested to grant permission for your child to be recorded by filling out the return slip below. The researcher will go on to interview the students as part of the study, and since the classroom presentation will be video recorded and students will be interviewed, you are hereby requested to do so.

Any data gathered in relation to this study that can be linked to your kid will be kept private and will only be disclosed with your consent. In neither written or spoken report based on this study will his/her name, your name, or the name of the school be connected to his/her involvement in the classroom. Such a report will solely be utilised for study. The involvement of your child in this study carries no known risks. Participation in the study will not directly benefit your child, but there may be indirect educational benefits, such as advances in mathematics teaching and learning techniques, which may ultimately benefit the learner's comprehension and performance of the subject.

You and your child will not be compensated in any way for taking part in this study. It is up to your child whether or not to take part in this study. Your child has the right to refuse or stop participating at any time. He or she won't be impacted in any way by withdrawal or disinterest. In a similar vein, you can consent to let your child participate in the study and then subsequently decide against it with no repercussions.

With the previous consent of the school and your child's teacher, the study will take place during regular class activities. If you do not want your kid to participate, there will be an alternative activity available for them after school to record what other students did during the class that was a part of the study. Your child must consent to participate in the study in addition to receiving your permission, and both of you will need to sign the assent form that is included with this letter.

Your child's involvement in the study and the information acquired from it will be safely saved on a password-protected computer in my locked office for five years after the study is over. Records will thereafter be deleted. The advantages of this study include that it will assist teachers in better integrating digital tools into their instruction, which the study predicts will increase students' performance in mathematics in seventh grade. As a result, the learner participating in this study has no known or anticipated risks.

Should you have any questions about this study please do not hesitate to ask me at +264 81 752 3424 or via email: jpaulus669@gmail.com or my study supervisor, Dr MM Masilo, Department of Mathematics Education, College of Education, University of South Africa, via email: masilmm@unisa.ac.za. Permission for the study will be granted by the principal and the Ethics Committee of the College of Education, UNISA.

Your signature below indicates that you have read the information provided above and have decided to allow your child to participate in the study. You may keep a copy of this letter.

Name of child: ……..

Sincerely,

I, (name of parent) ……agree/disagree (delete inappropriate), that my child may participate in this study.

Parent/guardian's Signature: _____ Date: _____

Johannes N Paulus _____

Researcher's name (print) Researcher's Signature Date:

Appendix F: Learner assent letter

Dear Learner

This letter serves as an invitation to consider your participation in a study.

A case study at the University of South Africa (UNISA) is being conducted by me, Johannes Natangwe Paulus, as part of my research for my Master's in Education. The study is titled, "EXPLORING THE CHALLENGES FACED BY GRADE 7 MATHEMATICS TEACHERS IN INTEGRATING DIGITAL TECHNOLOGIES TO TEACH DATA HANDLING: A CASE STUDY." The Department of Education and the College of Education's Ethics Committee at UNISA have approved the project and an Ethical Clearance Certificate (**Certificate No: 2021/09/08/61942553/18/AM**): has been obtained. You were specifically chosen by me so that I could gather reliable data for the study, as your school has the tools necessary for you to access digitalized lesson delivery. Let me tell you more about this project and what you would be expected to do if you decided to participate.

The findings of this study are significant because they will help policymakers and pre- and post-teacher training programmes understand the difficulties teachers face when incorporating digital technologies into their instruction of Data handling in Grade 7 Mathematics as well as how doing so might improve students' understanding of the subject. They can therefore think of potential answers to these problems.

Should you agree to undergo this study as a participant, you will go through the following during the study:

- Classroom observations and interviews

The researcher would like to observe you during Data handling periods for the entire duration of the topic. The researcher will observe how you are being taught while the teacher integrates digital technology and the challenges the presentations carry. The researcher would also like to observe how the use of computers in teaching the subject could enhance learning among learners. The researcher would like to ask you some questions after the topic is covered just so that the study is enriched further.

All information you provide through the interview or collected through observations will be considered completely confidential. Your name will not appear in any publication resulting from this study and any identifying information will be omitted from the report. However, with your permission, anonymous quotations may be used. Data collected during this study will be retained on a password-protected computer and other devices for 5 years in my locked office.

Furthermore, you may decide to withdraw from this study at any time without any negative consequences.

The benefits of this study are that teachers will be able to get recommendations that help them to improve their teaching of the subject as a whole and Data handling as a topic, and learners' benefit will be great on their enhancement topic acquisition and improved performance.

There are no known or anticipated risks to you as a participant in this study.

Your participation in this study is voluntary and you will not be reimbursed or receive any incentives for your participation in the research. The findings are accessible for one –two months after this study is done.

If you have any questions regarding this study or would like additional information to assist you in reaching a decision about participation, please contact me at +264 81 752 3424 or via e-mail at: jpaulus669@gmail.com, or my supervisor Dr MM Masilo at 012 429 6154 or by email at: masilmm@unisa.ac.za.

If you accept my invitation to participate, I request you to sign the consent form. I look forward to speaking to you and thank you in advance for your assistance in this project.

Yours sincerely,

Johannes Natangwe Paulus (researcher)

Learner assent

I, _____ (learner name), confirm that the person requesting my consent to take part in this research has informed me about the nature, procedure, potential benefits and anticipated inconvenience of participation. I have read and understood the study as explained in the information sheet. I have had sufficient opportunity to ask questions and am prepared to participate in the study.

I understand that my participation is voluntary and that I am free to withdraw at any time without penalty (if applicable). I am aware that the findings of this study will be processed into a research report, journal publications and/or conference proceedings, but that my participation will be kept confidential unless otherwise specified. I agree to the recording of the interviews and classroom observation. I have received a signed copy of the informed consent agreement.

Learner name & surname (please print) _____

_____ _____

Learner signature Date

Researcher's Name & Surname (please print): Johannes Natangwe Paulus

_____

Researcher's signature Date

Appendix G: Observation Checklist

Subject: Mathematics Grade 7

Topic: Data handling

Part	Good	Fairly	Poor	Comments
Aspect 1: How well the classrooms are equipped with digital resources.				
1.1 How well is the classroom equipped with digital tools?				
Aspect 2: Teachers' knowledge on technology integration into teaching.				
2.1 Teacher knows how to operate excel, tools and formatting.				
2.2 Content delivered is designed with a computer. How well or bad?				
2.3 Teacher does examples and data reports with the use of a computer.				
2.4 The teacher is passionate about operating computers.				

Aspect 3: Knowledge of technology as a teaching method				
3.1 Teacher displays graphics understanding.				
3.2 Teacher shows how to represent data using a computer.				
3.3 Teacher shows learners how to summarise and report data using a computer.				
Aspect 4: teachers' content knowledge in relation to technology				
Teacher uses technology to (show): 4.1 expertise knowledge of how to design and use yes/no and/or multiple-choice response questionnaires to collect data.				
4.2 expertise knowledge of how to organize and record responses from				

questionnaires on tables and tally charts.				
4.3 expertise knowledge of how to represent data on various types of bar graphs, broken line graphs, pictograms and pie charts (with not more than four sectors)				
4.4 expertise knowledge of how to extract and interpret information from tables, bar graphs, pictograms and broken line graphs.				
4.5 expertise in extracting and interpreting data represented in pie charts (with not more than 4 sectors, including measuring angles) and converting them to data.				
4.6 demonstrate expertise in finding the mode, median and mean of a set of data and draw conclusions and/or make predictions.				
Aspect 5: How the knowledge aspects influence each other in teaching and				

learning.				
5.1 The integration of digital tools in the classroom stimulates teaching and learning process.				
5.2 The knowledge categories (aspects) influence each other				
5.3 Learners demonstrate interest in being taught through the integration of technology.				
5.4 Overall presentation demonstrate the importance of technology integration into teaching.				

Appendix H: Interview Questions for Teachers

Interview Questions

Dear participant,

Kindly familiarise yourself with the following questions, at the end of your topic presentation I will request to interview you.

Interview questions to be asked to the teachers:

1. Tell me about your technological skills for teaching Data handling and your Mathematics teaching experience in Grade 7.

2. Have you undergone training in creating graphs, pie charts tally marks using a computer?

3. How do you understand technology integration into teaching and do you often integrate technology into your teaching?

4. Do you integrate technologies into teaching Mathematics?

5. What challenges do you encounter when integrating digital technologies into teaching?

6. How easy/difficult is it to integrate it into teaching Grade 7 Mathematics?

7. How easy/difficult is it to integrate digital technologies into teaching Data Handling in Grade 7 Mathematics?

8. What do you think is the impact of technology on Namibian education?

9. Do you think it is relevant/necessary to integrate technologies into teaching Data Handling in Grade 7?

10. What are your perceptions about teaching Data Handling in Grade 7 with the integration of digital technologies?

11. What other types of digital technology for teaching do you know and which ones do you have at your school?

12. What do you mostly use the types of technology you have at your school for?

13. Do you think your school is well equipped with technological tools that can be used for integration into teaching? Suggest any improvements.

14. With some motivation, do you think the curriculum gives enough room for technology1 integration into teaching?

15. Do you think the integration of digital technologies into teaching Data Handling in Grade 7 can help to improve the learners' performance in the topic?

Thank you for your participation.

Appendix I: Interview Questions for Learners

Learners' interview questions:

1. How do you feel about using computers in school?

2. How did you find teaching in a computerised classroom, was it interesting or not?

3. How is your performance in Mathematics in general?

4. How did you feel learning in groups where technology was being used?

5. How do you think that computerised lessons have helped you to improve?

6. Does the teacher always teach Mathematics with the use of the computer?

7. What did you miss during the presentations and what do you think caused that?

8. I saw that some of you could not correctly do some parts of the activities you were given, why maybe?