

TEACHERS' CREATION OF TEACHING AND LEARNING MATERIALS USING
INFORMATION COMMUNICATION TECHNOLOGY AT SELECTED REMOTE
SCHOOLS IN THE KHOMAS REGION, NAMIBIA

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ABSTRACT

The learning environment supports the role of the teacher, which is to organise, manage and help learners to navigate learning materials. In recent years, the advancement in Information Communication Technologies (ICTs) and access thereto, enable teachers to create teaching and learning materials. The purpose of this study was to investigate teachers' application of ICT knowledge and the challenges faced in the creation of teaching and learning materials for their classrooms at three public primary schools in the remote area of Khomas Region. The study adopted a qualitative case study and employed semi-structured interviews to collect data from teachers and non-participatory lesson observation to collect data from classrooms. Additionally, the study used purposive sampling to select teachers based on their years of teaching experience and computer skills while convenience sampling was used to find teachers who were available and willing to participate in the study voluntarily. The findings of the study revealed that teachers' comprehension of ICT varied greatly in the Khomas region's remote schools. Furthermore, it was found that majority of participants found it encouraging to use ICT tools as they make teaching materials appealing to learners, thereby boosting performance, and offering up-to-date materials. Moreover, the study revealed that most schools lacked sufficient ICT resources, and results indicated that only 33% of teachers began their lessons with teaching and learning materials created with ICT tools. The study also revealed challenges encountered by teachers during creating teaching and learning materials, include poor internet connections in the classrooms, shortage of ICT tools, lack of training, and lack of electrical power in the classrooms. As a result, the study concludes that, despite various ICT challenges experienced by teachers in Khomas region rural primary schools, teachers had adequate knowledge of how to use ICT tools.

Following the study's findings, the Ministry of Education, Arts, and Culture should make provisions for the infrastructure to be provided to all public schools to maximise the use of ICT in education. The government should also allocate funds for the maintenance and purchase of ICT consumables like reams of paper and printer ink.

Keywords: Education, ICT, Khomas region, Namibia, Teachers, Teaching and learning materials, TPACK.

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DEDICATION

I would like to dedicate this thesis to my mother, Febronia Shilikomwenyo Mwanyangapo and my friends Taimi Ndinelago Elifas and Martha Elias, who were my sources of motivation to complete this study.

DECLARATION

I, Eveline N. Ndakolo, hereby declare that this study is a true reflection of my research and that this work or part thereof has not been submitted for a degree in any other institution of higher education.

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LIST OF ABBREVIATIONS AND ACRONYMS

CK	Content Knowledge
CPD	Continuous Professional Development
FM	Frequency Moderation
ICDL	International Computer Driver's License
ICT	Information and Communication Technology
ICTED	International Conference on Teacher Education
IMTE	Integrated Media and Technology Education
IOL	Institute of Open Learning
IT	Information Technology
IUM	International University of Management
MoE	Ministry of Education
MoEAC	Ministry of Education Arts and Culture
NIED	National Institute for Educational Development
NPC	National Planning Commission
NTA	Namibia Training Authority
PCK	Pedagogical Content Knowledge
PK	Pedagogical Knowledge
SDG	Sustainable Development Goal
TCK	Technological Content Knowledge
TK	Technology Knowledge
TPACK	Technological Pedagogical Content Knowledge
TPK	Technological Pedagogical Knowledge
UNAM	University of Namibia

UN	United Nations
UNESCO	United Nations Education and Scientific and Cultural Organisation
WCE	Windhoek College of Education

CHAPTER ONE: INTRODUCTION

1.1 INTRODUCTION

One of the developmental milestones Namibia must reach in order to become a technology-based society by 2030 is the use of Information and Communication Technology (ICT) in education. The introduction of ICT in schools has enhanced pedagogical processes by integrating technology into the teaching-learning processes. The present study investigated teachers' use of ICT in the creation of teaching and learning materials in three selected remote schools in the Khomas Region of Namibia. This chapter presents the introduction of the study through a discussion of the background of the study, outlines the problem statement, presents the research questions, discusses the significance of the study, limitations and delimitations, and ends with the layout of the chapters.

1.2 BACKGROUND OF THE STUDY

The adoption of Information Communication Technologies (ICTs) in education is a global initiative that has now spread its tentacles across global education systems. Ratheeswari (2018) defines ICT as technologies (computers, laptops, tablets, mobile phones, projectors, the internet, etcetera) that provide access to information through telecommunication. The use of technology in education started in developed countries and spread to developing countries (Pelgrum and Law, 2003). Ghavifekr and Rosdy (2015) acknowledged the role played by the United Nations Education and Scientific and Cultural Organisation (UNESCO) in promoting the integration of ICT in the education system. As the principal United Nations (UN) body for education, UNESCO directs global initiatives to assist nations in comprehending the role that technology plays to hasten the achievement of Sustainable Development Goal 4 (SDG4), a goal encapsulated in the 17 SDGs (Ghavifekr & Rosdy, 2015). UNESCO disseminates information on how technology can facilitate universal access to education, close learning gaps, aid in the professional growth of teachers, and

improve the standard and relevance of education. Furthermore, UNESCO strengthens inclusion and enhances management and governance of the educational system to develop policy recommendations related to ICT.

In Namibian context, education, science, and technology have been identified as one of the driving forces toward the attainment of Namibian Vision 2030, which aims to raise the standard of life of Namibians to that of their counterparts in the developed world by 2030 (National Planning Commission, 2004). Furthermore, the Namibian Vision 2030 acknowledge the need for integrating ICT education and training into education and training system (NPC, 2004). In addition, the Namibian National ICT policy, seek to promote training of teachers for ICT related subjects (Ministry of Information and Communication Technology, 2009). Similarly, the Namibian ICT policy for education emphasised the need for use ICT tools in creating teaching and learning materials at all levels in the educational system in the country (Ministry of Basic Education, Sport and Culture, 2005). Therefore, the ICT policy framework in Namibia clearly encourage the use of ICT in creation of teaching and learning materials. It is therefore imperative to conduct studies on ICT use in Namibia in order to assess the progress for ICT implementation in Namibia and to provide recommendations for the future in terms of policy formulation and or review and implementation.

Several studies have been conducted in different part of the world to fast-track the progress made with regard to application of ICT in educational system and allow new innovations. Burns (2020) observes that in general, Africa has made considerable strides in the adoption of technology in education. The effort on information and communication technology for development is one of the most significant and forward-thinking concepts for technological change and innovation in Sub-

Saharan Africa. According to Bryant et al. (2020), technology is one of the ongoing initiatives that receive progressively more support and recommendations. An example is the laws governing online education, which Nigeria, Ghana, Sudan, and other countries have exploited to train teachers to handle ICT integration in the education system. However, despite these notable strides in the use of technology in education, Bryant et al. (2020) note that the majority of countries in Africa are affected by limited resources to successfully implement comprehensive ICTs into the classroom and from creating support materials.

Studies in Namibia show that there is a lack of ICT infrastructure in the country. According to Tendane and Amukeshe (2022), at least 1300 out of 1800 public schools in Namibia do not have basic technological infrastructures including computers, internet connections, and telephone lines. This situation affects mostly teachers in schools located in remote areas, as some parts of the country do not have adequate coverage of telecommunication networks and electricity. However, even though the majority of schools do not have adequate ICT infrastructures the situation is different in some urban schools. A study conducted by Dzambara (2012) on the distribution and use of teaching aids in Mathematics in Windhoek secondary schools in Namibia, reported that 42 teachers indicated that their schools have ICT tools including computers, laptops, and projectors. However, 36 of these teachers indicated that they never used these ICT tools when preparing for teaching. A study by Simon (2014) which was conducted in the same region, indicated that the majority of teachers at the schools where the study was conducted had received training on ICT as part of the Ministry of Education, Arts and Culture's programme and the Continuing Professional Development (CPD) initiative from their local schools. In light of this, it is observed that there is a discrepancy between the acquisition of knowledge by teachers and the application of this knowledge in creating teaching and learning materials in some schools in the Khomas region, in

Namibia. These studies were carried out in the capital city, Windhoek and the situation may be different in rural schools where there is a reported shortage of ICT infrastructures. Therefore, this study investigated teachers' application of ICT knowledge in creation of teaching and learning materials and the challenges faced in creating teaching and learning materials for the classrooms at three public schools in the remote area of Khomas Region, Namibia.

1.3 STATEMENT OF THE PROBLEM

The implementation of the ICT policy for education, supported by Namibia's National Development Plans and Vision 2030, is a major milestone in realising the nation's development goals and aspirations of achieving a technology-based society by 2030. The purpose of the ICT policy for education was to improve teachers' ICT proficiency and utilisation in the classroom (Ministry of Basic Education, Sport, and Culture, 2005). In addition, the introduction of ICT was always intended to enhance the delivery of high-quality education and to give teachers and learners access to technology skills (Rosenbusch, 2020 & Loveless, 2022). Consequently, some teachers received training in ICT skills and integration between 2007 and 2011 (MoE, 2012). Also, the national curriculum for basic education directs teachers to use a variety of teaching and learning materials, including materials created with ICTs, to enhance learning and make lessons more interesting (Ministry of Education Arts and Culture, 2016).

Despite the directive from the Ministry of Education that requires teachers to integrate ICT in teaching and learning as well as to create a variety of teaching materials, the Ministry of Education (MoE, 2010) reports that there is a serious lack of teaching and learning materials in subjects like Science and Mathematics in many schools, especially in remote areas. Sumra and Rajana (2006) indicated that many learners leave school without gaining the necessary skills because of the lack

of learning resources in schools. Furthermore, the studies by Isaacs (2007) and Mukuni (2019) on the use of ICT in education in Sub-Saharan Africa, show that these programmes lack evaluation and thus they are continuously faced with difficulties, particularly in remote areas.

At the moment, in Namibia, from the present researcher's perspective, little is currently known about teachers' use of ICT to create teaching and learning materials, especially in remote schools. However, even though related research on ICT integration in teaching and learning has been done, for instance, Simon (2014), Henoch (2015), and Iiping (2010), there is still a wide gap in terms of information on how teachers use ICT in creating teaching and learning materials, particularly in remote schools. This information is crucial in establishing the current status of ICT use in the creation of teaching and learning materials, particularly in the education systems in the country, and identifying challenges faced by teachers when using ICTs. Therefore, this study aimed to investigate teachers' application of ICT knowledge in the creation of teaching and learning materials in three selected remote primary schools in the Khomas Region in Namibia. The study also uncovered challenges faced by teachers when using ICTs.

1.4 RESEARCH QUESTIONS

The main goal of the study was to investigate teachers' use of ICTs in the creation of teaching and learning materials in remote schools in the Khomas Region. As a result, the researcher formulated research questions that helped to answer the research problem. The main question that guided this study was: “What are teachers' knowledge and understanding of the value of creating teaching and learning with ICT?”

The following sub-questions informed the main question:

1. How do teachers apply their ICT knowledge to create teaching and learning materials for their classrooms?

2. What challenges do teachers experience in creating teaching and learning materials using ICT?

1.5 SIGNIFICANCE OF THE STUDY

The goal of the study was to investigate the application of teachers' ICT knowledge and to uncover the challenges in the creation of teaching and learning materials in Khomas Region remote primary schools. As a result, the knowledge gained is helpful to the Ministry of Education, particularly to curriculum developers and managers for future considerations in terms of ICT developments in the Namibian education sector. Furthermore, the study's findings are useful for teacher education institutions to evaluate their ICT integration curricula and to create technological knowledge improvements for pre-service teachers.

1.6 LIMITATIONS OF THE STUDY

This study was limited to three remote primary schools in Khomas Region. The sample was too small to generalise findings to the whole region. Therefore, future studies should cover more schools and regions to get a broader understanding of the use of ICT in the creation of teaching and learning materials countrywide and enable appropriate measures to be put in place. The use of interviews and observations could have introduced some interviewer and observer bias. Lastly, due to Covid-19, schools had imposed restrictions such as wearing masks, using hand sanitisers, and a 1.5 m distance that the researcher needed to adhere to.

1.7 DELIMITATIONS OF THE STUDY

The study was conducted at three primary schools in remote areas of the Khomas Region. These schools were considered because they are rarely considered in routine programmes and they are located in an area characterised by low-economic status, hence this study found it necessary to focus on them. Other schools in the Khomas region, particularly those in urban areas, were not

considered for this study because most of these schools have good ICT setups, and teachers at these schools have access to ICT support. Furthermore, it is believed that learners in urban schools are familiar with ICT tools and ICT-created learning materials compared to learners in remote schools. Therefore, this study was confined to determining the use of ICT in creating teaching materials because this area is considered critical in delivering effective teaching and learning.

1.8 DEFINITIONS OF THE TERMS

In this study, the terms and concepts relevant to this study were defined and should be understood as follows:

1.8.1 Information and Communication Technology (ICTs)

A set of technological tools and resources used to communicate, create, broadcast, store, and manage information. These tools and resources include hardware, software, and connection (Tinio, 2015).

1.8.2 ICT tools

Computers, laptops, data projectors, tablets, cameras, and scanners are examples of ICT tools that are used for a variety of purposes (Green et al., 2005).

1.8.3 ICT policy

A set of regulations or guidelines established by the government to direct decisions about ICT-related issues, particularly those pertinent to education, such as telecommunications, the internet, computers, and printers (Nicol, 2003). According to Simon (2014), rules are established to instruct users (teachers) on what is expected of them when integrating electronic technology

1.8.4 Teaching and learning materials

This includes textbooks, library books, newspapers, periodicals, printed materials, charts, recordings, videotapes, images, exhibitions, slides, transparencies, online resources, speakers and other personnel resources, and other technology-based materials (Nyawira, 2015).

1.8.5 Challenges

Refers to any situation that makes it difficult or impossible to make progress or attain a goal (Schoepp, 2005).

1.8.6 Remote schools

Schools in districts where teachers have little access to resources impair teachers' abilities to educate students (Rahmadi et al., 2010). These schools are situated outside of cities or towns.

1.9 THESIS STRUCTURE

This study is organised into five chapters that cover the background, literature review, methodology, findings, discussion, recommendations and conclusions. The chapters are outlined as follows:

1.9.1 Chapter one: Introduction

This chapter provides an overview of background information on the creation of teaching and learning materials using ICT both globally and locally, as well as the statement of the problem, research questions, and the significance of the research. The chapter also provides limitations, delimitations, and operational definitions for terms used throughout the study.

1.9.2 Chapter two: Literature review

This chapter starts with the definition of ICT and then reviews the literature on the use of ICT in education. The creation of teaching and learning materials using ICTs than discussed. The chapter also discusses the teaching and learning materials as well as the challenges in the use of ICT in

education. The chapter ends with the theoretical framework, which focuses on the logic that underpins the study.

1.9.3 Chapter three: Research design and methodology

This chapter describes the research design and methodological processes used in this study. The chapter outlines the research strategies and instruments used, data collection and analysis procedures as well as the research ethics.

1.9.4 Chapter four: Presentation of findings

Based on the study's two sub-research questions, this chapter discusses the findings. Biographies and school profiles of the participants are also included in the chapter. The results are presented using tables and figures.

1.9.5 Chapter five: Discussion of findings, conclusions, and recommendations

This chapter discusses the findings that answered the primary research question of this study: “What are teachers' knowledge and understanding of the value of creating teaching and learning with ICT?” The findings are discussed by comparing and contrasting them with those of previous relevant studies. Furthermore, the chapter provides the study's findings, conclusion, and recommendations. The conclusions take into account the research objectives and they are thus presented following the research objectives and research findings in chapter four.

CHAPTER TWO: LITERATURE REVIEW

2.1 INTRODUCTION

This chapter reviews the literature on the use of ICTs to create teaching and learning materials. The study identified a gap in the literature on Namibia regarding how teachers use ICTs in their creation of teaching and learning materials. The chapter focused on the definition of ICT, the application of ICT in education, the challenges experienced in the creation of teaching materials using ICT and lastly, the theoretical framework which discussed TPACK.

2.2 DEFINITION OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

In general, information and communication technology (ICT) refers to communication and computer technologies that are utilized for data transfer and storage (Ekwelem, 2019). According to the United Nations Educational, Scientific, and Cultural Organization (UNESCO), ICTs are tools that enable society to produce, gather, consolidate, share, manage, and process information in multichannel and diverse digital mediums (UNESCO, 2023). These tools include computers, TV, mobile phones, and the Internet (UNESCO, 2023). This definition is also shared by Ratheeswari (2018) who defined ICT as technologies that provide access to information communication technologies such as wireless networks, the internet, and other communication methods. Furthermore, Kreijnsa et al., (2014) referred to ICT as tools that enable, support, and reinforce educational reform. Therefore, for the purpose of this study, ICT refers to all communication tools and technological devices, such as computers, projectors, printers, and so on, that teachers could potentially use to create teaching and learning materials.

2.3 USE OF ICT IN EDUCATION

According to Sachdev et al. (2007), ICT has become essential in education to improve the efficiency and effectiveness of teaching and learning at all levels and in both formal and informal

settings. (Adu et al., 2020) observed that ICT revolution is radically changing the nature of learning and knowledge production, hence transforming the world in unprecedented ways. This has assisted the paradigm change from traditional instructional, pedagogical, and instructional approaches to more current and innovative technology-based teaching and learning methods (Tella & Adu, 2009; Desai, 2010; Assar, 2015; Bhattacharjee & Deb, 2016). Traditional educational environments, according to Yelland (2001), do not appear to be ideal for educating learners to operate or be productive in today's workplaces. This is because in the past teachers focused only on the available teaching and learning materials instead of having multiple teaching materials. But, when a variety of teaching and learning materials are present in class, the use of ICT improves learners' ability to learn (Desai, 2010). Therefore, educators use ICT tools to improve instructional methods by connecting to the internet and browsing through Web pages to get relevant information.

In addition, when teachers use ICT tools for learning across the curriculum, this allows all learners to become knowledgeable, intelligent, creative, and productive ICT users (Tella & Adu, 2009), and this enables learners to share learning resources, encourage learner-centered, collaborative learning concepts and problem-solving abilities (Batiibwe et al., 2016). On the other hand, to ensure quality education delivery to the learners, teachers need to be prepared to deal with various forms of ICTs and to keep up to speed with new information to make the teaching and learning process easier and enjoyable (Bhattacharjee & Deb, 2016). This is because ICTs alone will not bring about improvement in education quality if teachers do not have the knowledge and skills to use ICTs (Mbwana, 2011). Therefore, teachers need to build capacity in the use of ICTs in the creation of teaching and learning materials. With ICT tools, teachers can access modern teaching and learning that motivates and involves learners in the subject being taught (Pedagoo, 2020).

The use of ICT in education has been on the rise in many parts of the world. However, in the African context, a survey conducted by Isaacs et al. (2007) in 53 African countries found a significant disparity in the provision of ICT between urban and remote schools. Institutions such as the University of Namibia (UNAM) and International University Management (IUM) in Namibia, offer training modules for pre-service teachers, namely, Integrated Media and Technology Education (IMTE) and Information Technology (IT) for teachers respectively. UNAM introduced the IMTE module into the Bachelor of Education honours degree programme in 2011 which aims to show future teachers how to effectively use ICT and other educational media in the classroom and enable them to communicate using a variety of standard technologies and non-digital media (Boer et al., 2021). Similarly, the University International Management (IUM) offers a module called Information Technology (IT) Skills for teachers. This module aims to provide student teachers with the skills and knowledge to use computers and all Microsoft applications through hands-on exercises. In addition to information technology skills for teachers, the same institution offers integrated teaching technology in the classroom and focuses primarily on the use of media and technology in the classroom. However, is not clear whether teachers in the Namibian education system are up to speed with the use of ICT in creating teaching and learning materials.

2.3.1 ICT in the creation of teaching and learning materials

Previously, chalk, dusters, and blackboards were considered necessary teaching and learning materials (Kumar, 2017). However, the rapid development of ICT in education has reduced teachers' usage of chalk to write on the blackboard and spoken presentation of the subject content (Bhalla, 2013 & Busljeta, 2013; David & Vera, 2017). Today teachers can use ICT tools to create various teaching and learning materials. Mocanu and Deaconu (2017) explain that ICT tools are

those that allow learners and teachers to access a huge amount of information in a variety of media (text, photos, graphics, audio, video, and so on) that are necessary to support learning objectives, learners' characteristics, and the school.

The teaching process is made easier today as teachers use various ICT tools such as computers, the internet, laptops, printers, etc. to create teaching and learning materials, record keeping, and distance learning (Budhwar, 2017). As indicated in the research carried out by the central school teachers in India, ICT tools like computers are used to update subject knowledge and teaching skills, make lesson plans, and create additional teaching and learning material such as posters, handouts, and books via the internet (Bhalla, 2013). Teachers need to make use of ICT tools properly in the creation of teaching and learning materials for learners to gain a better understanding and expand their knowledge as the best way to learn requires practicing. Busljeta (2013) points out that nowadays, teaching is difficult without the use of a variety of modern teaching and learning materials. Thus, teachers need to make use of teaching and learning materials such as diagrams, images, graphics, and animation as well as audio and video clips of real-time operations to clarify essential topics (Majumdar, 2015).

A study conducted in Europe on Social Studies teaching resources in the 21st century (David & Vera, 2017) indicates that teachers can use the internet to access the most up-to-date teaching and learning materials from all across the world. This means that teachers can make use of the internet to download a video as teaching materials that match the learning objective and use it in the classroom to assist the learners to understand the subject content. Also, when learners are made to see, hear, feel smell, and even taste, there is a higher degree of understanding and appreciation subject matter taught (David & Vera, 2017). In addition, by using multimedia on a computer, teachers can blend text, video, images, and animation. Multimedia is a computer-based system that

can blend text, video, graphics, animation, and interactivity with other types of content (Dianta et al. 2021). Similarly, Assar (2015) indicates that simple learning materials (such as a video sequence or a quiz) can be combined to create more complex educational materials, which can then be distributed on their own as a CD-ROM or as an interactive online experience. Thus, when a visual-aural combination is used in conjunction with the textbook and syllabus, it can help learners understand complex concepts and reasoning in a short amount of time (Dahiya et al., 2016).

Apart from that, teaching and learning materials can be created with a laptop, smartphone, and camera and printed out to be used in hard copies. Bacheri et al. (2018) explain that printed teaching materials are needed to supplement previously utilised non-printed teaching resources and the use of printed materials is seen to be more targeted because the exercises needed direct learning activities without the use of computers, as well as the potential to be copied with a computer. In contrast, Radha and Sakthivel (2021) point out that printed materials are sometimes of low quality and out of date and textbook reading is sometimes boring and does not assist learners in learning and remembering concepts. In addition, according to Mocanu and Deaconu (2017) who conducted a study in Romania on the use of ICT in teaching methods in vocational education and training in tourism highlighted some ICT tools (Classtool net, Creately.com, Popple.com, Bubbl.us, and Powtoon.com) and their uses. Below is a brief description of how teachers can make use of these ICT tools in the creation of teaching and learning materials (Mocanu & Deaconu, 2017).

- **Classtools.net** is a Web 2.0 application that allows teachers to use templates to develop various activities, games for students, and study materials. People utilise this tool to make slide presentations or presentations based on the information offered by a cube's facets (brainbox template).

- **Creately.com** is a web tool that allows users to make charts, graphs, and logic schemas by either utilising the online version or downloading the programme to their computer.
At the same time, it may be used as a collaborative tool, with multiple users from various computers working together to create a graph.
- **Popplet.com** is a Web 2.0 tool that allows you to quickly and easily create maps and schemas. Images, videos, and texts can all be included in presentations, which can be developed collectively.
- **Bubbl.us** is a web 2.0 tool for organising data and creating mind maps to better understand, remember, and produce new ideas.
- **Powtoon.com** is a Web-based animation software that allows students and teachers to make animated presentations quickly and easily by manipulating pre-made objects, imported images, music, and speech recorded by users.

Findings from a study conducted in Namibia on the challenges faced by English teachers in integrating ICT in teaching reading and writing in rural primary schools in the Omusati region and urban primary schools in the Khomas region (Nuuyoma, 2012). The findings indicated that all respondents in rural primary schools said that they had never received training, while in urban primary schools, only 40% of teachers had not received ICT training. This indicates that there are teachers in remote schools that do not have ICT knowledge and are unable to create teaching and learning materials. Therefore, the current study aimed to investigate teachers' use of ICT in the creation of teaching and learning materials in three selected remote schools in the Khomas Region of Namibia

2.3.2 TEACHING AND LEARNING MATERIALS

As explained in Chapter One, teaching and learning materials include textbooks, library books, newspapers, periodicals, printed materials, charts, recordings, videotapes, images, exhibitions, slides, transparencies, online resources, speakers, and other personnel resources, and other technology-based materials (Nyaawira, 2015). Teachers need to create modern teaching and learning materials to teach subject content because a variety of teaching and learning materials in the classroom make the lesson more interesting and understandable to the learners (David & Vera, 2017). However, in the past, the lecture mode of teaching dominated the classroom, and essential equipment such as chalk, a duster, and a chalkboard was present (Kumar, 2017) and books were difficult to obtain (Maryono, 2016). Therefore, the creation and use of teaching and learning materials can assist learners to acquire alternative information for taught subjects.

In a study that was conducted in Malaysia on the benefits of ICT for developing instructional materials in vocational high schools (Maryono, 2016), the findings revealed that information and communication technology (ICT) is extremely beneficial in the production of teaching materials such as papers, books, modules, and other similar items. Moreover, the Tanzanian study on teachers' practical use of ICT tools to make supplemental teaching and learning materials in secondary schools (Sugiyava, 2005) noted that teachers frequently used photocopies to duplicate materials even though they created the handouts by hand.

To enhance the teaching and learning of particular subjects, teachers can now use ICT tools like the internet and search engines on the World Wide Web to find relevant and engaging images (Sugiyama, 2005). This means that teachers can use a variety of ICT tools, such as computers, the internet, laptops, scanners, televisions, and cell phones, to create worksheets, modules, books, wall charts, graphs, audio and video recorders, posters, drawings, and photographs to help learners to

understand. Furthermore, David and Vera (2017) point out that teachers can use the internet to find the most up-to-date information from around the world, thereby making the topic easier for learners to understand. For example, according to Budhwar (2017), by using audio and visual materials, teachers can add a practical element to the theory given in class, and learners can have a greater comprehension of the topics being covered.

2.4 CHALLENGES IN THE USE OF ICT IN EDUCATION

Although teachers have been exposed to a variety of programmes, some schools in remote areas have reported a severe shortage of teaching and learning materials in subjects such as mathematics and science, and teachers are encouraged to explore various ICTs to deliver high-quality lessons (Ministry of Education, 2010). The steering committee for the ICT Implementation Plan Guide in education lists all levels and sectors of the MoE, as well as governmental, business, and civil society partners who support ICTs in education. The steering committee identified the following educational priorities for the introduction and use of ICTs throughout the education sector (MoE, 2006 p. 20):

1. ICT utilisation for teacher research, planning, and development,
2. Integrating of ICTs into educational instruction,
3. ICT literacy for learners,
4. ICT as a subject for learners, and
5. ICTs for educational management.

Since ICT, such as computers and the Internet, provide teachers with numerous opportunities and tools for improving the teaching process and classroom materials (Lazar, 2015), teachers face numerous obstacles and challenges when using ICT to create teaching and learning materials

(Salehi & Salehi, 2012). Such challenges may deter teachers from using ICT in the classroom and from using ICT to generate supporting materials.

Various researchers have identified several challenges that affect the use of ICTs in education, such as poor connectivity, a lack of skills, insufficient technological help in schools, and maintenance issues, have all been observed (Salehi & Salehi, 2012; Ghavifekr et al., 2016, Panigrahi, 2016). In addition, some researchers have identified insufficient time, a lack of confidence, time constraints, and a lack of equipment as challenges that hinder teachers from using ICTs to prepare teaching materials for the classroom (Habibu, 2012; Mndzebele, 2013 & Ramoral, 2013).

The following parts look at some of the major challenges that hinder effective ICT usage in education.

While various pieces of research focused on the challenges of integrating ICT into education, Namibia also faces challenges after the implementation of the ICT policy in education in 2005. In 1995, the Ministry of Education (MoE) formulated an ICT policy through the National Institute of Educational Development (NIED). This policy has undergone some changes to ensure the quality use of ICT in education (Isaacs, 2007). The steering committee for ICT education was established by the Ministry of Education in February 2004 to coordinate policy implementation. The ICT policy aims to prepare the Namibian people to engage in the world of ICT (Ministry of Basic Education, Sport, and Culture 2005). This means that teachers with ICT skills and knowledge can use ICT to search, prepare, and present materials for teaching and learning. Then through Tech / NA! The implementation Plan (Ministry of Education, 2006 and the ICT Policy for Education (Ministry of Basic Education, Sport, and Culture, 2005) equipped the teachers with the necessary ICT knowledge and skills to use ICTs to research, plan and develop materials through various programmes that include International Computer Driver's License (ICDL). There are several notable ICT-related challenges experienced by teachers which include lack of adequate training, insufficient time, and adoption inertia, lack of resources, poor connectivity, lack of support, contextual challenges, and maintenance.

2.4.1 Lack of adequate training

Teachers need skills and knowledge to integrate ICTs in the creation of teaching and learning and such skills and knowledge can be obtained through various training. Lack of knowledge and skills in the use of ICT tools (Mndzebele, 2013) hamper the use of quality teaching and learning materials. Boer et al. (2021) indicate that most Namibian primary teachers need to be skilled in the creation and use of ICT-based teaching and learning materials. There was also a study that was conducted in Uganda on the difficulties faced by teachers in using ICT in classroom teaching-learning in technical and higher educational institutions (Habibu, 2012). The findings, through observation, showed that teachers were found to be inadequate in knowledge and skills, and they were hesitant to make improvements or include extra learning linked with computers into their teaching techniques.

2.4.2 Insufficient time

Many teachers know about the use of computers in the classroom, (Ghavifekr et al., 2016 & Habibu, 2012), but still, they only use them sparingly since they do not have enough time. This is because in school teachers are tasked with a variety of activities in addition to teaching, including administrative duties (Mndzebele, 2013). Therefore, there isn't enough time to create, develop, and integrate technology into teaching and learning. Similarly, Simon (2014) states that teachers need more time to prepare for hand-outs, notes, and development assessment activities.

In addition, ICTs demand teachers to have some extra time because there is a need to learn the application software to be able to create new teaching and learning materials (Mbwana, 2011). In addition, some teachers end up having insufficient skills and knowledge (Ramorala, 2013) as they are obliged to attend ICT training in the afternoons (after school hours), which causes exhaustion

because teachers would have often spent half of their workday in the classroom before attending the training. Also, teachers who commute from diverse places rely on various modes of transportation after school. This simply means that staying after hours requires teachers to look for other alternatives to get home after the training which results in them incurring extra costs.

2.4.3 Adoption inertia

Challenges of ICT adoption are linked to a lack of skills and culture. According to Naresh and Sree Reddy (2015), some teachers may be threatened by a lack of skills in using ICT tools and hence they will react by resisting change. This challenge has been confirmed by theories of technology such as the Technology Acceptance Model and the Diffusion of Innovation Model which acknowledge how a lack of skills results in resistance. Contributing to how a lack of skills may result in resistance to adopting ICT in teaching by teachers, Dube (2020) indicates that failing to use the technology effectively in front of learners and other teachers frustrates the teachers and this may result in resistance. A study conducted and reported by Naik et al. (2020) in rural India, found cultural inertia among old teachers as a cause of resistance to adopting ICT tools. The old teachers defended the old ways of teaching and claimed that they had always achieved good academic results without ICT.

2.4.4 Lack of resources

Mingaine (2013) points out that the use of ICT in teaching and learning needs some hardware and software resources that are sometimes unavailable in schools, particularly those located in remote areas. The cost of acquiring these infrastructures may be out of reach of these institutions. A study conducted by Dube (2020) on the state of ICT use in education in South Africa's rural schools found the presence of old donated ICT resources. These resources were not functioning and most

of them were outdated. A related challenge was in some schools, in that though the resources were available, there was no electricity connection. Without electricity in schools, ICT integration in teaching remains a pipe dream. Therefore, the lack of resources is a significant challenge in the adoption of ICT in teaching and learning and as noted by Albrahim (2020), this challenge can be solved by creating a budget for ICT in schools. The budget should be separate from other needs so that it is focused on ICT only.

2.4.5 Poor connectivity

The results of the study on the problems of using ICT tools in education by Salehi and Salehi (2012) revealed that teachers are eager to include ICT in the classroom. But, due to limited Internet and ICT access, teachers are unable to use ICT in the classroom (Ghavifekr et al., 2016). This means that without an internet connection, teachers are unable to obtain teaching and learning materials related to learning objectives, such as from websites or blogs. Moreover, rural and remote schools experience issues of poor connectivity (Panigrahi, 2016) and this stops teachers from accessing information from the internet during lesson presentations (Simon, 2014). Equally so, research conducted in Kenyan public schools in the Nakuru North district teachers (Serah, 2014) found that bad network connections prevent crucial information from being downloaded and shared.

2.4.6 Lack of support

Naresh and Sree Reddy (2015), note that the introduction of ICT in schools requires all key stakeholders' support. While parents may isolate themselves from ICT business in schools, Naresh and Sree Reddy (2015), regard their participation as critical to the success of ICT integration in schools. The community not only provides resources but also lends the psychological support that

the learners require. According to Murgor (2015), the fact that learning goes beyond school means that parental involvement is important because they support learning at home. The challenge as noted by Albrahim (2020) is that some parents regard school business as the concern of teachers and parental involvement not only inspires the learners but offers opportunities to learn at home. Naresh and Sree Reddy (2015) suggest the creation of an ICT committee at school that includes parents so that participation is formalised.

2.4.7 Contextual challenges

Butcher (2013), considers the environment under which ICT in teaching and learning is applied as either conducive or non-conducive. There is a need for security hence space for storage of all ICT equipment should be secured. In addition, the ICT resources should be available when wanted. A study conducted by Dube (2020) in South African rural schools found some schools so dilapidated that the security was too compromised to keep the ICT infrastructure. In most cases, the teacher's work is done beyond working hours, especially planning for the next day's lessons, and failure to finish the work at school may require the teacher to work after a normal working day and if using ICT gadgets at school, the teacher can find it difficult to proceed with the work at home. These environmental and other contextual challenges present challenges to the teacher.

2.4.8 Maintenance

According to Ramorala (2013), at some schools, there are no qualified technicians on the school grounds to tackle maintenance issues. Therefore, schools hire outside technicians who travel long distances, which is costly for the school, and the issues in schools occasionally hamper the normal operation of teaching and learning. Thus, Mbwana (2011) suggests that schools need ICT technicians for the reason that sometimes when the equipment breaks down it can take a long time

before it is repaired, and this can be discouraging if the repair is not completed on time. Another challenge experienced is that the schools that are using computers supplied by the private sector or purchased by the government always have difficulties in maintaining and upgrading the computers when the project is finished. As such, the learners turn to be responsible for the computer's maintenance (Mndzebele, 2013).

Despite the numerous challenges to the use of ICTs in education, Sugiyama (2005) and Salehi and Salehi (2012) suggest that to incorporate ICTs into the curriculum, teacher training institutes should provide adequate and necessary support for teachers. According to Mndzebele (2013), the usage of ICT has the potential to significantly improve each country's educational system. Simply explained, if teachers know how to use ICTs, they may create teaching and learning materials.

2.5 THEORETICAL FRAMEWORK

For teachers to make use of ICT tools, first they need to acquire knowledge and skills on how to use these tools. In addition, teachers receive training on teaching methodology. The Technological Pedagogical Content Knowledge (TPACK) framework integrates knowledge and pedagogy with the use of information technology to help teachers acquire pedagogical knowledge and skills while also improving student teaching (Naziri et al., 2019). Therefore, TPACK is an important component of ICT that needs to be investigated when conducting studies on the application of ICT in creating teaching and learning materials. This allows the researcher to get an understanding of teachers' pedagogical knowledge used in teaching and learning.

The Technological Pedagogical Content Knowledge (TPACK) theoretical framework by Mishra and Koehler (2006) is used to guide this study. This framework is based on the pedagogical and

content knowledge (PCK) concept, which Schulman first proposed in 1986; hence it is not completely new. In other words, PCK is the framework's supporting structure. PCK's main principles, according to Graham et al. (2014) demand teachers to comprehend the material of a certain subject and build relevant instructional strategies and skills that are suited for the learners. Whereas, the TPACK framework was further developed to focus on understanding teachers' knowledge needed to integrate technology into education (Ammade et al., 2020). Aside from content and pedagogical knowledge, the framework includes technological knowledge and recognising the role that technical knowledge may play in effective teaching and learning (Baran et al., 2009).

Mishra and Koehler (2006) indicate that the TPACK framework is made up of three overlapping knowledge spheres: technological knowledge, pedagogical knowledge, and content knowledge. The interplay of three basic forms of knowledge: content (CK), pedagogy (PK), and technology (TK) are attempted to be evident through Pedagogical Content Knowledge. As a result, the framework is made up of seven interconnected components: technology knowledge (TK); content knowledge (CK); pedagogical knowledge (PK); pedagogical content knowledge (PCK); technological content knowledge (TCK); technological and pedagogical knowledge (TPK); technological pedagogical content knowledge (TPACK). Figure 1 illustrates the intricate interactions between the seven components.

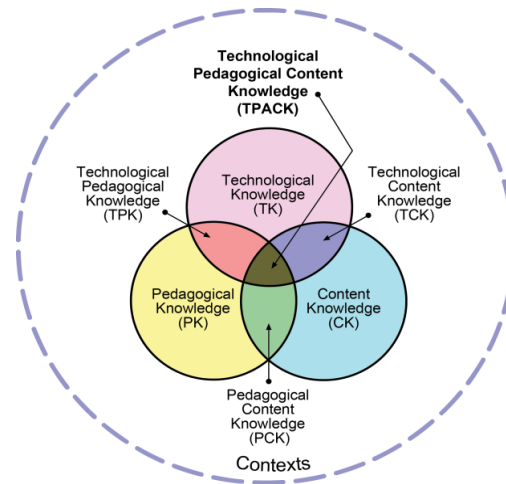


Figure 2.1: Components of the TPACK framework (picture taken from <http://tpack.org/>)

According to figure 2.1, TPACK is the result of the intersection of the three knowledge fields of knowledge, Pedagogical, Content and Knowledge (PCK), the Technological Pedagogical Knowledge (TPK), and the Technological Content Knowledge (TCK), each of which was created by the intersection of three fundamental knowledge components, namely, technology, pedagogy, and content. In addition, the figure also demonstrates that the type of technology used in the creation of teaching and learning materials is highly dependent on the particular subject and the intended method of delivery to the learners. In light of this, the TPACK idea in the creation of teaching and learning materials making use of technology has the potential to reshape both the pedagogical subject knowledge and classroom environment. In addition, Batiibwe et al. (2016) indicated that the effective creation of instructional materials with technology requires TPACK. However, teachers need a thorough understanding of the seven components of the TPACK framework shown in the figure above to organise and apply technology, pedagogy, and content in the classroom.

Churchill et al. (2012) argue that TPACK is considerably more than just incorporating technology into lesson plans; so teachers must be able to develop effective technology-enhanced pedagogies

and show how technology improves the character of the subject matter by resolving issues and rebuilding knowledge. Nonetheless, TPACK is used as lenses in this study to understand more about teachers' knowledge of how to use technology to create teaching and learning materials (Mishra & Koehler, 2009). TPACK is an essential part of today's educational system because it takes into account the increasing need for the use of technology in the classroom while maintaining the emphasis on the subject matter and how it is taught (Voogt & Mckenny, 2017). Furthermore, the authors indicate that TPACK prepares a variety of learning and teaching materials for both learners and fields of education for the future. The seven components of TPACK are explained below as they are used in this study.

TPACK is a crucial component of today's educational system because it takes into account the rising need for the use of technology in the classroom while maintaining the emphasis on the subject matter and how it is taught. Consequently, it prepares education for the future and students for their future. To successfully use TPACK in their courses, teachers must be fully up to speed with and educated about the curriculum and its components. The TPACK framework is essential to this study because it is required in the use of ICT to create teaching and learning materials. Furthermore, this study has assessed the use of TPACK and its components in the creation of teaching and learning materials and the utilisation of such materials in classrooms.

2.5.1 Technological knowledge (TK)

This refers to the abilities needed to operate specific technologies. The knowledge includes information on a wide range of technologies, including the internet, digital video, interactive whiteboards, and software programs (Mishra & Koehler, 2006). In this study, TK refers to teachers' knowledge and abilities to use numerous technology tools to create teaching and learning materials

from low technology such as pencil grip, highlighter, tactile ruler, visual schedules, calculator, cassette player, audio recorder, overhead projector, and others to high technology such computers, laptops, smartphones, iPods, whiteboards, overhead projectors, tablets, and so on. This means that teachers must be able to use the various technologies that are available in the creation of teaching and learning materials.

2.5.2 Content knowledge (CK)

This is the real subject area of knowledge that is to be learned or taught (Mishra & Koehler, 2009). Teachers must understand the topic they will teach as well as how the nature of knowledge differs between content areas. The skill level of a teacher's subject matter expertise can be used to assess how well teachers can produce high-quality instruction, even when they employ comparable teaching techniques and procedures (Sarjoni et al., 2020). A teacher who is knowledgeable about the subject will always be aware of the teaching and learning materials required for a given piece of content and will be able to use ICTs to help create those materials.

2.5.3 Pedagogical knowledge (PK)

This is the application of knowledge to the practice of teaching in a way that is engaging for the learners to learn. According to Shulman (1987), PK is an understanding of teaching principles and procedures, which involves an understanding of classroom teaching and learning such as approaches methods and tactics, strategies, curriculum and syllabus, testing and assessments, and recovery and enrichments. In a similar vein, Koehler and Mishra (2009) define PK as the knowledge of classroom management, assessment, lesson planning, and the learning environment. All teachers should acquire a wide range of pedagogical knowledge, abilities, and attitudes to succeed in today's educational system and to encourage learners to learn, as well as everyone who

aspires to the position of teacher must equip oneself with the necessary information, attitude, and pedagogical abilities (Sarjoni et al., 2020).

2.5.4 Pedagogical content knowledge (PCK)

This is the teacher's knowledge of making the subject matter clear to the learners. According to Shulman (1986), this knowledge is about the teaching process and differs depending on the content area, as it includes both content and pedagogy to enhance teaching methods in specific areas. Moreover, Mishra and Koehler (2009) explain PCK as the transformation of the subject matter that takes place when a teacher interprets the content, comes up with different methods to convey the topic, and adjusts to changes in the teaching materials to fit new concepts and the learners' prior knowledge. In light of this, using a variety of teaching and learning materials made with ICTs always produces the greatest results if teachers are knowledgeable about the subject and also know the best approach to impart it to learners.

2.5.5 Technological content knowledge (TCK)

This is the teachers' understanding of how technology can be used to create a new presentation for a specific type of content. For example, teachers can make use of computers and Microsoft applications to create learning materials for the learners such as lesson plans, handouts, topic tasks, topic tests, investigations, examinations, and others for specific content. Teachers, according to Mishra and Koehler (2009), must understand not only the topic matter they teach but also how the subject matter can be improved through the use of technology. In addition, TCK is the type of knowledge that relates to how technology can be used to give new ways of teaching information (Niess et al., 2009).

2.5.6 Technological Pedagogical Knowledge (TPK)

Mishra and Koehler (2006) refer to TPK as the understanding of the existence, components, and capabilities of various technologies as they are used in schools, as well as the understanding of how teaching may change as a result of the usage of specific technologies. This means that teachers should be aware of how various technologies can be used to create teaching and learning materials for a certain topic. TPK requires teachers to reject the use of ICT tools fixedly all of the time but requires teachers to develop abilities that go beyond the most typical use of available technology and reconfigure it to produce innovative lesson plans and teaching methods in the classroom (Hench, 2015). Teachers in TPK, for example, can use a computer or a smartphone to download visual content or photographs that are relevant to the discussion in a way to engages learners in the teaching process at a distance.

2.5.7 Technological pedagogical content knowledge (TPACK)

Mishra and Koehler (2006) assert that teachers need technological pedagogical content understanding to integrate technology into the creation of teaching and learning materials in their subject areas. By teaching content using suitable pedagogical methods and technologies, teachers acquire an intuitive understanding of the intricate interplay between the three basic components of knowledge (CK, PK, and TK). In addition to subject matter expertise and an understanding of what makes for effective instruction, teachers need to be familiar with the technology that will support teaching methods and, the academic development of the learners (Setyawan, 2014).

Teachers must have a thorough understanding of the seven components of the TPACK framework described above to organise and apply technology, pedagogy, and content in the classroom (Baran

et al., 2009). This means that teachers can use TPACK to develop appropriate teaching and learning materials to improve learners' understanding and performance.

2.6 CHAPTER SUMMARY

This chapter presented an overview of the literature that covers content that is in line with the purpose of this study. The researcher reviewed the meaning of ICT and how it is used in education. The chapter also included research on the use of ICT in the creation of teaching and learning materials. Furthermore, the researcher looked at and reviewed the literature on teaching and learning materials. It further discussed the challenges that teachers face when using ICTs to create teaching and learning materials. The last part of the chapter discussed the theoretical framework (TPACK) that was used in the study to understand and assess teachers' knowledge of how to use ICT to create teaching and learning materials. The next chapter discusses the research methodology that was utilised to collect data for this study on how teachers create teaching and learning materials using ICT in remote primary schools.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This chapter describes the research design and methodological processes that were followed in this research study. The study aimed to investigate teachers' ICT knowledge and to uncover the challenges in the creation of teaching and learning materials using ICT at selected remote schools in the Khomas educational region of Namibia.

3.2 RESEARCH DESIGN

Saunders et al. (2007) define research design as a general blueprint for how a researcher would address research questions. To collect primary data for this study, a descriptive research approach will be used. According to Kothari (2004), descriptive research is a type of research that uses surveys and other fact-finding procedures to explain the current state of events. Furthermore, a qualitative research approach was used to collect data through interviews and field observations in a case study of three schools located in the remote area of Khomas region, Namibia.

3.2.1 Case study

This research study employed a qualitative case study method by focusing on teachers' use of ICT in the creation of teaching and learning materials in three remote schools from the Khomas region in Namibia. The three schools were treated as samples from the Khomas region and not separate cases. A case study method was chosen to allow for a better comprehension of the research topic while reducing the possibility of bias resulting from various case conditions. This is because in a case study, participants' behaviours and environmental conditions are not manipulated, and there is nothing that is performed to alter the context or individuals in the study (Baxter & Jack, 2008).

Qualitative case studies have been defined in a variety of ways by researchers. According to Rule and John (2011), a case study is a methodical in-depth examination of one specific example within

its environment. In the same vein, Bertram and Christiansen (2014) note that case studies are a type of research that is frequently used by researchers. According to Elifas (2021), a researcher can use case study techniques to go beyond quantitative statistical results to comprehend the behavioural circumstance from the actor's perspective. In a case study, one or more cases can be investigated.

3.2.2 Qualitative approach

This study embraced a qualitative approach to collecting data using interviews and field observations. Creswell (2014) describes the research approach as plans and procedures that cover everything from general assumptions of specific data collection, analysis, and interpretation methodologies. According to Bhawna and Gobid (2015), the research approach can be categorised as quantitative, mixed-method, and qualitative research.

Babbie (2020) explains quantitative research as a process that involves the collection of numerical data and as presenting a view of the relationship between theory and research as a deductive and objectivist conception of social reality, with a preference for a mutual science approach. In the same vein, Elifas (2021) defines quantitative research as the systematic empirical analysis of observable phenomena using statistical, mathematical, or computational methods.

The purpose of quantitative research is to create and test mathematical models, ideas, and hypotheses about phenomena (Bhawna & Gobid, 2015). However, mixed methods involve both qualitative and quantitative approaches. Creswell (2014) explains the mixed-method research design as a method for collecting, analysing, and combining quantitative and qualitative research and methods in one study to better understand a research problem. Qualitative research is broadly defined as any kind of research that produces results without the use of statistical analysis or any

other means of quantification. Blaikie (2003) emphasises that qualitative methods are used when data are in words and remain in words throughout the analysis. Moreover, Greenhalgh and Taylor (1997) argue that researchers who use a qualitative approach seek a deeper truth and aim to study things in their natural setting, attempting to interpret phenomena in terms of the meanings people assign to them and using a holistic approach which preserves the complexities of human behaviour.

In this study, a qualitative approach was utilised since it is a method for examining and understanding how individuals or groups respond to social or human problems (Creswell, 2014). Thus, the approach allowed the researcher to acquire a better understanding of the creation of teaching and learning materials using ICT and reduced the possibility of bias by weakening a single individual's goal (Grenier & Merriam, 2019). In addition, Creswell (2014) indicates that qualitative data are normally collected in the participant's setting. The present research collected data from the classrooms which are the participants setting.

3.2.3 Sample

A sample is a smaller group of the entire population. In this study, six teachers from three remote schools in the Khomas Region were chosen as participants using a purposeful and convenient sampling method. Purposive sampling, according to Singh and Masaku (2014), is a strategy in which specific situations, people, or events are purposefully chosen to give essential information that cannot be acquired through other means. In addition, Elder (2009) states that instead of randomisation, the researcher selects participants based on personal criteria. Purposive sampling is one of the most frequent sampling procedures in that group participants are based on pre-determined criteria relevant to a certain research question (Farr, 2008).

In the current study, the researcher selected schools in the Khomas Region characterised by low-economic levels and remote (outside of Windhoek city limits). Also, teachers were purposively selected based on the following criteria: teachers with computer skills and four (4) or more years of teaching experience. Besides purposive sampling, convenient sampling was utilised to identify teachers who are accessible and willing to engage in the study voluntarily. Singh (2015) points out that this sampling method comprises participants who are most easily accessible to the researcher and meet the criteria. Singh further mentions that many of the constraints connected with research can be avoided by using convenient sampling.

3.3 RESEARCH INSTRUMENTS

Two research instruments were employed in this study to generate the research data: a non-participatory observation schedule guided by the TPACK framework and a semi-structured interview guide.

3.3.1 Observation

Observation, as defined by Creswell (2012), is a set of specific instruments for acquiring open-ended, first-hand data by observing people and places at the research site. Johnson and Christensen (2017) add that observation is a significant method of data collection since it allows the researcher to observe real activity rather than just preference reports. Participant observation and nonparticipant observation are the two types of observation. According to Bryant (2006), participant observation includes the researcher being a member of the group being observed. In nonparticipants, on the other hand, the researcher observes the participants' behaviour and surroundings without interfering with their activities (De Trigueros, 2017).

In this study, the researcher employed nonparticipant observation by entirely focussing on TPACK to look at teachers' knowledge of the creation and development of teaching and learning materials utilising ICT, especially in remote locations in schools. During observation, the researcher used the classroom observation schedule in Appendix A to gather data. The data was gathered by looking at the learning materials that were available in the classroom (for example how the classroom posters were created), observing the nature of the teaching and learning materials used by teachers throughout the presentation of lessons as well as how the lesson plan was prepared.

3.3.2 Semi-structured interview

To answer research questions on teachers' creation of teaching and learning materials, a semi-structured interview guide was used (Appendix B). A semi-structured interview is a set of questions that are prepared ahead of time corresponding to the research question to guide the data collection during the interview (Ary et al., 2010). This instrument was chosen because of its flexibility which enables the researcher to explore new areas and gather information. In addition, De Trigueros (2017) points out that when the goal is to learn about people's viewpoints, understandings, and meanings about events and experiences in their life, a semi-structured interview is typically utilised. In the study, the researcher used interview questions to gather descriptive to reflective answers from participants. Thereafter, the researcher interviewed six teachers from three distinct remote schools to learn more about the participants' knowledge of the creation of teaching and learning materials, the challenges they face, and their understanding of the necessity of teaching and learning in the classroom.

3.4 PILOT STUDY

Lowe (2019) defines a pilot study as preliminary research that is conducted before the main study. This means that the researcher needs pre-testing of the classroom observation schedule and

interview guide to produce high-quality outcomes. As a result, a pilot study was required to determine whether the proposed instruments were challenging or appropriate for the researcher (Van Teijlingen & Hundley, 2002). In this study, the researcher chose one of the three schools to act as a pilot study. The school was chosen for the pilot of the study due to the convenience of the setting and the accessibility of the informants (Yin, 2009). Then, four grade three teachers were selected to participate in the pilot project and they were observed whilst presenting their lessons and how the presence of teaching and learning materials in their classrooms was created. These participants were selected because pilot studies are normally conducted on persons who are as close to the target population as feasible but not on those who will be included in the final sample, hence these teachers were selected to avoid bias (Simkus, 2022). After then, the interview took place, and a voice recording device was put to the test.

3.4.1 Findings from the pilot study

The results of the pilot study helped the researcher to modify both the observation schedule and interview guide. The observation schedule was adjusted by including all the components of TPACK (technology knowledge; content knowledge; pedagogical knowledge; pedagogical content knowledge; technological content knowledge; technological pedagogical knowledge; technological pedagogical content knowledge). During the interviews, the researcher identified misunderstandings in the information given to participants as well as how to use proper language, proofread, and spell-check the questions. Consequently, the interview guide's fifth question, the first of which asked, "How do you understand ICT?" was clarified for the participants because some did not know that ICT stands for Information Communication and Technology. Additionally, the outcome of the interviews prompted the development of a related question about what inspires teachers to use ICTs.

3.5 DATA COLLECTION PROCEDURE

Firstly, the researcher visited the schools during school hours and observed 18 lessons using an observation schedule (see Appendix A). During classroom observation, the researcher sat at the back of the classroom and took notes on the nature of the teaching and learning materials present and used in the teaching session. The main reason for conducting classroom observation was to look directly at what is happening at the schools rather than relying on the second information. Cohen et al. (2018) also explain that data collected by the observation is first-hand because the researcher visits the study location which can be a school, a classroom, or a staffroom.

In addition, observation was necessary for this study because it provided the researcher with information that participants might not have wanted to reveal in the interview. Thereafter, with the permission of the participants, a semi-structured interview was conducted with each teacher at the end of the school day (see Appendix B). Each interview lasted for 30 minutes and was audio-recorded to collect more information on how teachers create teaching and learning materials and the challenges they experience. Therefore, a semi-structured interview was vital because this allowed participants to express themselves and disclose challenges or difficulties that the researcher had not anticipated (De Trigueros, 2017). The interview assisted the researcher to gather data and generate knowledge that could not be immediately observed during the observation stage.

3.6 DATA ANALYSIS

Qualitative data analysis is the process of describing, classifying, and connecting phenomena with the researcher's conceptions (Graue, 2015). Graue further points out that the goal of data analysis is to provide a complete description of the event as well as the ability to compare and contrast several circumstances based on their similarities and differences.

Thematic analysis was used to analyse qualitative data in ATLAS.ti version 22 software. Thematic analysis is a type of data analysis technique that involves searching through a set of data to identify, evaluate, and report on similar patterns (Braun & Clarke, 2006). Therefore, in this study, similar-sounding statements in the responses of participants were given the same coded labels, and their frequency of occurrence was determined. Therefore, coded statements were derived from these data to allow the comparison of responses of different participants. This is supported by Guest et al. (2014) who state that thematic analyses focus on detecting and defining both implicit and explicit ideas within the data, that is, themes, rather than counting specific words or phrases. Furthermore, according to Majumdar (2015), the thematic analysis gives a brief explanation and interpretation of data collection in terms of themes and patterns. Thematic analysis was used for interview responses and to summarise the data in graphs.

In addition to qualitative data collected from teacher interviews, qualitative data was also collected from lesson observations, which were summarised in frequency tables in Microsoft Excel 2016. Furthermore, frequency tables of variables that were counted during lesson observations were computed in Microsoft Excel 2016. Finally, the analysed data was used to answer the research questions of this study.

3.7 TRUSTWORTHINESS

Bless et al. (2013), supported by Creswell (2013), indicate that data trustworthiness in qualitative research is equivalent to reliability and validity in quantitative research. In this study, the following four dimensions of data trustworthiness were addressed.

3.7.1 CREDIBILITY

Credibility is equivalent to internal validity and according to Fouche et al. (2021), it concerns the accuracy and truthfulness of the results. Credibility in this study was addressed by strictly following all the steps of the research process. In addition, after analysing the results, they were taken to the participants to verify whether the results were representative of what they provided. Furthermore, methodological triangulation was employed in this study to ensure the consistency of results obtained using two data collection methods (observation and interview). Triangulation is the process of using several techniques, data gathering techniques, and data sources to provide a more comprehensive picture of what is being examined and to cross-check the data (Gay et al., 2011).

3.7.2 Dependability

The term "dependability" describes the consistency and reliability of the extent to which research techniques are documented, thereby enabling the third party to track, audit, and evaluate the methodological approach, as well as research results (Streubert, 2007). The research methods and instruments used in this study were well documented in this chapter to ensure the dependability of the study. In addition, the observation checklist and interview questions are presented in appendix A and B respectively, to enable third parties to audit and evaluate the data collection tools used for this study.

3.7.3 Transferability

Transferability is a measure of the research's external validity that describes how well findings from one study can be applied to theory, practice, and future studies (Moon et al., 2016). To achieve this, the research methodology followed has been similar to the past studies, which allows the comparability of the present findings to the findings of past research and original theories.

3.7.4 Conformability

Conformability involves different researchers conducting the same study and getting similar results (Leavy, 2017). In this study, conformability was addressed through participant validation and quoting the participants verbatim. Participants were asked to confirm whether the results reflected the data they contributed. The participants confirmed that the data reflected what they contributed and the results were considered of quality.

3.8 Research ethics

The researcher obtained ethical clearance from the University of Namibia's Ethical Clearance Committee to carry out the research. Thereafter, permission was sought from other relevant gatekeepers such as the Executive Director of the Ministry of Education, Arts, and Culture. Subsequently, the researcher informed all relevant structures as well as the principals of the schools concerned. Then, established social science ethical principles were observed by ensuring that the privacy of research participants is respected by obtaining voluntary and informed consent. Moreover, the researcher was sensitive to the work and social contexts of the research participants to ensure minimal disruptions to them in the research process. Lastly, to guarantee the anonymity and confidentiality of the participants, pseudonyms were used, while collected data was stored in a password-protected folder on a personal computer and will be deleted as per the University's guidelines.

3.9 CHAPTER SUMMARY

This chapter described the research methodology used to conduct this study. The researcher started by describing the research design, sample, and research instruments used during data collection and analysis for this study. Furthermore, the researcher discussed the findings from the pilot study. In addition, the researcher further described data collection analysis procedures and ended with a

presentation of the ethical considerations of the study. Thus, the research methods and instruments used to conduct this study were broadly discussed to allow the dependability and transferability of the study's findings. In the next chapter, the findings obtained from observations, interviews, and data analysis are discussed in depth using literature.

CHAPTER FOUR: PRESENTATION OF FINDINGS

4.1 INTRODUCTION

This chapter presents and discusses the results of a study titled "Teachers' creation of teaching and learning materials using ICT at selected remote schools in the Khomas Region, Namibia." The main research question for this study was: "What are teachers' knowledge and understanding of the value of creating teaching and learning materials with ICT?" This question was informed by two sub-questions: (1) "How do teachers apply their ICT knowledge to create teaching and learning materials for their classrooms?" and, (2) "What challenges do teachers experience in creating teaching and learning materials using ICT?" To answer the research questions, data used was collected through the researcher's observation and interviews of teachers at three different schools in the Khomas Region. The order of this chapter follows the objectives of this study. The chapter begins with the introduction in Section 4.1, followed by the overview of data analysis in Section 4.2, then the matching of findings to research questions in Section 4.3, the presentation of results for research questions one and two in Sections 4.4, and 4.5 respectively and the chapter end with a summary of the chapter in Section 4.6.

4.2 OVERVIEW OF DATA

The researcher collected data from three schools through classroom lesson observations. In addition, six teachers, two from each school participated in this study's interviews. Twelve lessons two from each teacher were observed by the researcher during this study. The teachers and schools that participated in this study were given coded labels which are presented in Section 4.2.1. The biographical information of teachers and school profiles is described in Sections 4.2.2 and 4.2.3.

4.2.1 Meaning of codes

The code system that was used to represent schools and participants of the research interviews in the present study is shown in Table 4.1. The code system was used to ensure the anonymity of both participants and schools.

Table 4.1: Description of codes used to represent schools and respondents

School codes	Teachers Codes
School A (SA)	Teacher A (TA)
	Teacher B (TB)
School B (SB)	Teacher C (TC)
	Teacher D (TD)
School C (SC)	Teacher E (TE)
	Teacher F (TF)

4.2.2 Schools' profiles

To answer the research questions, this study used data collected from three schools. Table 4.2 shows the profiles of the schools. The data shows that all three schools were located in Namibia's Khomas Region. Furthermore, the three schools were from different clusters, with schools A, B, and C belonging to the Freud, Plato, and Bloom clusters, respectively. The highest grade in all schools was grade seven. School A was a small school with only five teachers and 85 learners, followed by School C with 13 teachers and 303 learners, whereas School B had the most staff members with 32 teachers and 1143 students.

Table 4.2: Schools' profiles

School	Region	Cluster	Highest grade/class	Number of teachers	Number of learners	Participants
A	Khomas	Freud	Grade 7	5	85	2
B	Khomas	Plato	Grade 7	32	1143	2
C	Khomas	Bloom	Grade 7	13	303	2

4.2.3 Participants' biographical information

The biographical information of participants was described using six variables in Table 4.3. The data shows that the youngest participant in this study was 28 years old while the eldest was 54. Furthermore, the years of participants' teaching experiences ranged from four to 13 years of service. In terms of the highest education qualification attained, most of the participants (4 out of 6) had Honours degrees while two had diplomas. All qualifications were obtained from Namibian tertiary institutions, with IOL and WCE having the most representation (two each). Furthermore, the data shows that the majority (4) of participants had Mathematics as a major subject followed by Natural Science, English, and Afrikaans. However, only three participants were teaching their majors at the schools.

Table 4.3: Biographical information for respondents

Teacher	Age	Years of service	Training institute	Highest qualification	Major subjects covered in training	Subject taught at school
TA	28	5	IOL	Honours degree	Natural Science and English	English and Afrikaans
TB	30	6	IOL	Honours degree	Mathematics and Natural Science	Mathematics and Natural Science
TC	54	12	WCE	Diploma	Mathematics and natural science	Natural Science and Afrikaans
TD	29	4	UNAM	Honours degree	Mathematics and English	Mathematics and English
TE	36	4	IUM	Honours degree	Mathematics and Natural Science	Mathematics and Natural Science
TF	37	13	WCE	Diploma	English and Afrikaans	English and Afrikaans

4.3 MATCHING OF FINDINGS TO RESEARCH QUESTIONS

This study was conducted to answer two distinct questions on how teachers apply ICT knowledge to create teaching and learning materials for their classrooms as well as on what challenges teachers face when developing teaching and learning materials using ICT. The results of the present study are presented in Sections 4.4 and 4.5 based on the two research questions. Sub-research question one was answered by considering the use of TPACK through lesson observations and interview questions 1-7 (Table 4.4 and Appendix A), while research question two was answered through interview questions 8-10 (Table 4.4 and Appendix B).

Table 4.4: Lessons observation and interview questions used to answer respective research questions

Research Question	TPACK Observation Checklist	Interview Questions
SRQ1: "How do teachers apply their ICT knowledge to create teaching and learning materials for their classrooms?"	Number 2: TK, TCK, TPK, CK, PK, PCK, and TPACK.	Question number 1-7.
SRQ2: "What challenges do teachers face when developing teaching and learning materials using ICT?"	Not used.	Question numbers 8-10.

4.4 SUB-RESEARCH QUESTION 1: “HOW DO TEACHERS APPLY THEIR ICT KNOWLEDGE TO CREATE TEACHING AND LEARNING MATERIALS FOR THEIR CLASSROOMS?”

The first research question for this study was, "How do teachers apply their ICT knowledge to create teaching and learning materials for their classrooms?" To answer this question, data were gathered through lesson observation, which was supported by teachers' interviews. This section is split into two parts. Part A presents results from the interviews while Part B presents results from the researcher's lesson observations. Results are presented in Sections 4.4.1 to 4.4.2 which present the findings.

Part A

To assess how teachers apply their ICT knowledge to create classroom teaching and learning materials, two teachers from each of the three schools were interviewed. In this section (Part A), the results from the interviews of participants are presented. The interview component had four questions that were asked to all six participants.

4.4.1 Definition of ICT

Participants were asked to define Information and Communication Technology (ICT). Their responses were coded in ATLAS.ti, version 22, where similar-sounding statements were given the same labels to determine response similarity. According to the findings, Teacher A defined ICT as a source of information that includes media and communication tools (Fig. 4.1). Teachers B and C referred to ICT as a communication tool. According to Teacher D, ICT is anything that is not a pen. Furthermore, Teacher E and Teacher F included modern technological devices and teaching aids in their definition of ICT (Fig. 4.1).

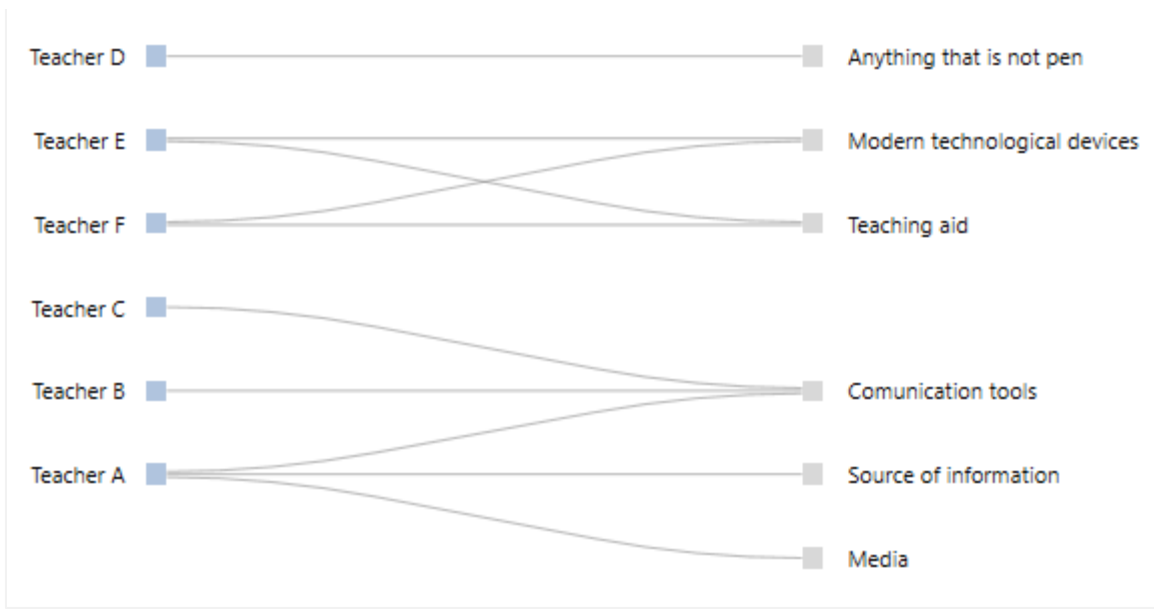


Figure 4.1: Sankey diagram showing coded teachers' definition of ICT

Participants were also asked to provide a list of ICT tools available at their schools. Table 4.5 shows the complete list. The results show that all schools had a comparable number of available ICT tools, except tablets for learners and the Paratus network, which were only reported to be available at school A, and a learners' computer laboratory, which was only reported to be available at school C. Furthermore, all schools were found to have important ICT tools such as laptops, projectors, photocopiers, printers, scanners, desktop computers, internet, electricity, and radios. However, these tools were available in very limited numbers, ranging from one to three for each school (Table 4.5).

Table 4.5: Teachers' lists of the ICT tools available at school (N= six teachers)

ICT Tool	Number of ICT tools		
	School A	School B	School C
Laptop	2	3	2
Tablets for learners	20	0	0
Projector	1	1	1
Photocopy machine	1	1	1
Printer	1	2	1
Scanner	1	1	1
Desktop computer	1	2	2
Set of speakers	0	1	1
Internet	Yes	Yes	Yes
Electricity	Yes	Yes	Yes
Paratus network	Yes	No	No
Learners computer laboratory	No	No	1 lab with 24 computers
Radio	1	1	1

4.4.2 Use of ICT tools in creating teaching and learning materials

To assess the use of ICT tools by teachers in creating teaching and learning materials, participants were asked the following question (Sub-research question 2): "How do you make use of ICT tools to create teaching and learning materials?" Six teachers provided answers which were analysed in ATLAS.ti version 22 qualitative research tool, where similar-sounding statements were given the same coded labels and their frequency of occurrence in all six responses was determined (Fig. 4.2).

According to responses, all participants used ICT tools to type learners' activities, which was followed by the download of teaching and learning materials which was shared by five participants (Fig. 4.2). Printing and projecting lesson contents were the third most common use of ICT tools, as shared by three participants, while the development of pre-recorded lessons was the least common use of ICT tools, as shared by only one participant (Fig. 4.2).

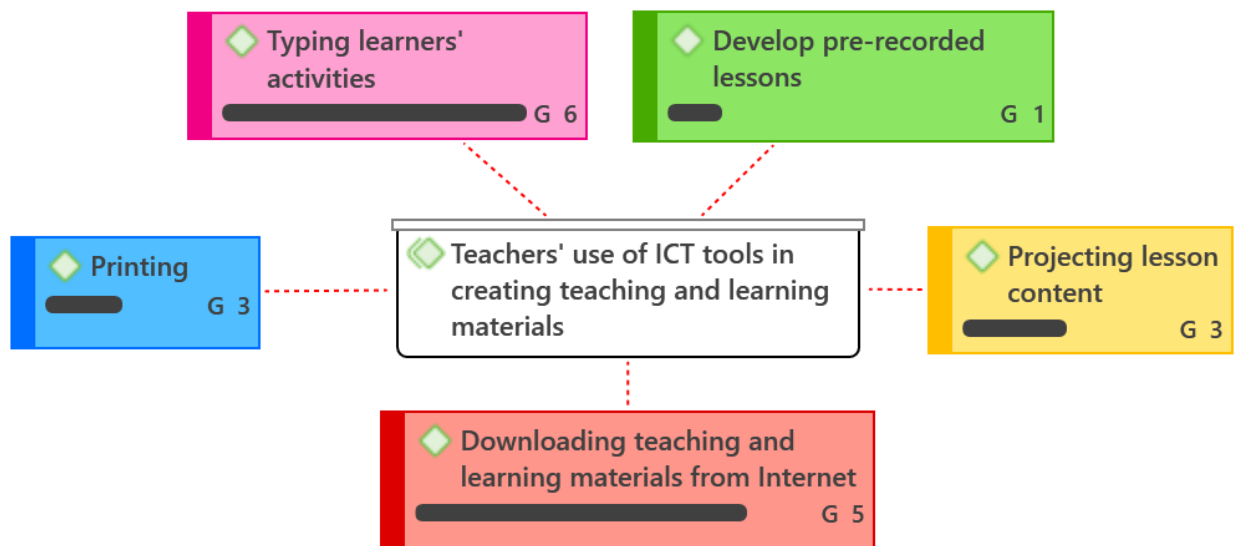


Figure 4.2: Teachers' use of ICT to create teaching and learning materials.

According to the figure, G represents the frequency of occurrence of the statement in participants' responses.

When participants were asked to give specific examples in which they have used ICT to create teaching materials, Teacher A stated that:

“In the lesson for English I taught the previous day on listening comprehension I got a video and a story from You-tube and came up with questions for the learners that I typed. During the lesson, I read the questions three times to them before allowing learners to listen to the person in the video reading the story so that they can answer the questions and then, I played the video three times.” (Teacher A).

Teacher B stated that:

“If one goes through my learners' books like in the test book, I type most of their tasks and tests that they pasted. Most of the time I type the summary, print it out and make copies that are not enough for everyone sometimes, and what I do is to allow them to share like two per handout.” (Teacher B).

Teacher C stated that:

“My learners' activities are prepared with ICTs. For example, the tests, worksheets, handouts, and examinations are typed. In addition, I have some pictures, contents, and words around my class wall that were created with the computer but I colour them with my learners because we only print in black and white.” (Teacher C).

Teacher D stated that:

“As I mentioned earlier that I prepare my posters by using ICT tools, I download the pictures and type the content, printing out, cutting, and pasting it. I also indicated that I do type my learners' activities, for instance, tests, tasks, homework,

investigation, and projects. I prepare my lesson plan with my laptop.” (Teacher D).

Teacher E stated that:

“I use the overhead projector. This is because I believe that learners learn better by seeing. In addition, I also have some assessments in a file like tasks, tests, and projects that I type.” (Teacher E).

Teacher F stated that:

“I have a resources file that consists of my topic tasks, tests, and projects/ practical investigation, and most of them are typed. My lesson plans, exercises, and homework - I just write because it is very hard to have access to a computer/laptop and printer every day. I have a folder on my laptop of different teaching and learning materials I developed like PowerPoint of lesson presentations, exercises, tasks, tests, audio, videos, etc. but I hardly use them because sometimes there is no projector to show presentations, no printer, or no ink.” (Teacher F).

4.4.3 Teachers’ motivation for using ICT tools

Participants were asked to mention what motivates them to use ICT tools. Their responses were summarised by applying thematic data analysis through coding and their frequency rates were determined in ATLAS.ti version 22. The results indicated that the majority of participants (4) were motivated by the fact that ICT motivates learners to learn and that ICT simplifies work (Fig. 4.3).

According to Teacher B:

“ICT tools make my work easier. ICTs provide a variety of teaching and learning and they make the teaching process productive. It also motivates learners to learn because they see interesting pictures, videos/audios, and neat work and I notice

that most learners learn through seeing rather than just listening without seeing anything.” (Teacher B).

Furthermore, the present study also revealed that three participants were motivated to use ICT tools because they improved the appearance of teaching materials, increased work efficiency, and provided updated materials. For example, according to Teacher A:

“In my case I find ICT tools to make my work easier. Even when I am showing a video with my laptop, all the learners can see and hear clearly. It makes posters look attractive to learners. It shortens my work as I am teaching many grades. ICTs avail updated materials that allow learners to open up specifically here at the farm where children are not exposed to information on what is happening in the world.”

(Teacher A).

The fact that ICT improves the storage of teaching materials was shared by two participants as the least motivating factor for using ICT tools (Fig. 4.3).

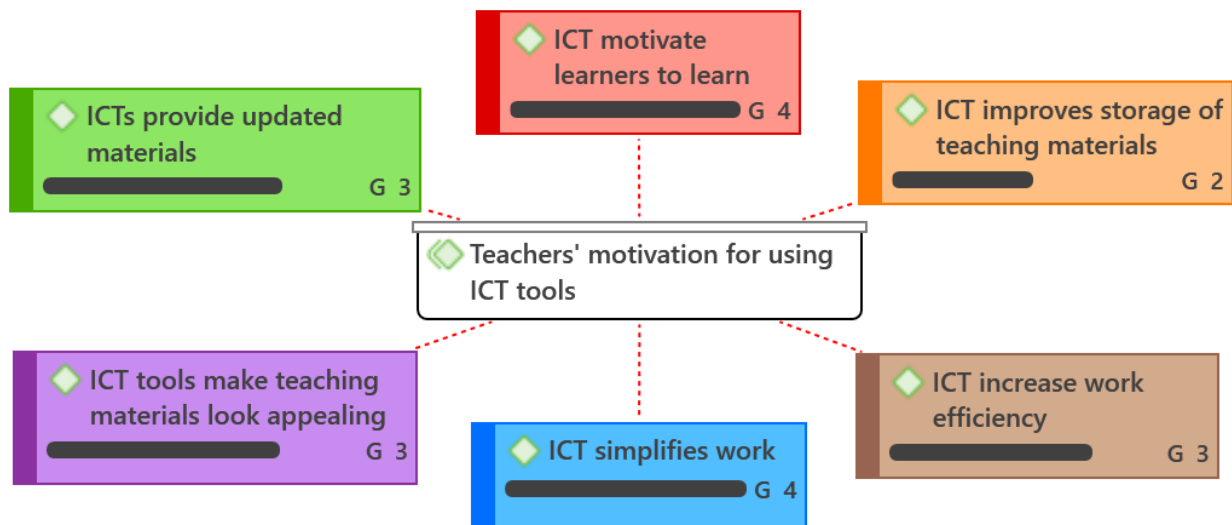


Figure 4.3: Factors that motivate teachers to use ICT tools.

In the figure, G represents the frequency of occurrence of the statement in participants' responses.

Part B

This section presents findings from the researcher's lesson observations as carried out at the three schools that were considered for this study. In total, 12 lesson observations were conducted to assess how teachers apply their ICT knowledge to create classrooms' teaching and learning materials by focusing on the Technological Pedagogical and Content Knowledge (TPACK). According to Niess (2011), TPACK is a framework that describes the knowledge teachers need to develop, implement, and evaluate teaching methods using technology. This section (Part B), presents the findings for the seven TPACK components: TK, TCK, TPK, CK, PK, PCK, and TPACK.

4.4.4 Technological knowledge (TK)

The application of teachers' technological knowledge in the creation of teaching and learning materials was assessed through three components: the use of ICT tools in classrooms during lesson observations, teaching and learning materials created with ICT tools available in the classroom, and lesson introduction using ICT-created teaching and learning materials. The findings of the three components are discussed below.

4.4.4.1 Use of ICT tools in the classroom during lesson observations

Based on the observations of 12 lessons, the internet, and mobile devices were the most frequently used ICT tools, with 100% usage, followed by computers or laptops (Table 4.6). Some teachers were observed using mobile phones to access the internet during the lesson. Even though teachers indicated that most of these tools were available at schools, no radios, speakers, overhead projectors, smart boards, or interactive whiteboards were used in any of the 12 lessons observed.

Table 4.6: ICT tools used in class and their frequencies during the researcher’s lesson observation

(N=12 lessons)

ICT tool	Frequency	Percentages (%)
Computer or laptop	6	50
Radio	0	0
Speaker	0	0
Overhead projector	0	0
Smartboard	0	0
Internet	12	100
Interactive whiteboard	0	0
Mobile devices (e.g. personal cell phone)	12	100

4.4.4.2 Teaching and learning materials created with ICT tools available in the classroom

This section presents findings from lesson observations conducted to assess the availability of teaching and learning materials created with ICT tools in classrooms. The results are shown in Table 4.7. According to the observations of 12 lessons, all classrooms had posters with typed texts. Furthermore, all classrooms had teaching and learning materials printed in appropriate font size, and all handouts, pamphlets, and study guides distributed to learners during lessons were created using ICT tools. It was also found that posters designed with ICT (using Microsoft Word and Adobe Design) were found in eight classrooms (67 %) (Table 4.7). Some classrooms, however,

had handwritten posters. Only five (42 %) classrooms used different font colours on teaching and learning materials (Table 4.7), with the rest using black and white.

Table 4.7: Frequencies and percentages of ICT-created teaching and learning materials available in the classroom during the researcher's lesson observation (N= 12 lessons)

Teaching and learning materials created with ICT are available in the classroom	Frequency	Percentages (%)
Posters are designed with ICT (using Microsoft Word, and Adobe design)	8	67
Texts on the poster are typed (Microsoft Word)	12	100
Teaching and learning materials are printed and cut out)	12	100
Different font colours are used on teaching and learning materials	5	42
Appropriate font size is selected for the learners	12	100
Handouts, pamphlets, study guides, etcetera are prepared using the computer	12	100
Relevant graphs, charts, books, and diagrams are created using ICT (Microsoft Word and Excel)	4	33

4.4.4.3 Lesson introduction using ICT-created teaching and learning materials

This section contains the findings of lesson observations conducted to determine whether teachers use teaching and learning materials when introducing lessons. The results are shown in Table 4.8. Twelve lessons were observed, and only 33 % of the lessons were introduced with posters made with ICT tools. The findings also reveal that no ICT-created graphs, charts, drawings, audio recorders, or video recorders were used to introduce lessons. However, some teachers choose to begin their lectures using handwritten charts.

Table 4.8: Frequencies and percentages of ICT-created teaching and learning materials used for lesson introduction during the researcher's lesson observation (N= 12 lessons)

An appropriate introduction (teacher uses teaching and learning materials created with ICT)	Frequency	Percentages (%)
Graphs	0	0
Charts	0	0
Posters	4	33
Drawing	0	0
Audio recorder	0	0
Video recorder	0	0

4.4.5 Technological content knowledge (TCK)

Results for the evaluation of teachers' use of TCK in the classroom showed that the majority of participants (58%) used a variety of teaching and learning materials using ICT for the specific topic content presentation that is appropriate for learners' mental abilities (Table 4.9). Additionally, the findings revealed that only 27% of the participants used teaching materials to evaluate learners' prior knowledge using ICT-created materials (Table 4.9). For instance, during one lesson, the teacher requested the learners to mention the names of plants from their surroundings that were depicted on a poster. For the presentation of specific subject content, participants also used printed textbooks.

Table 4.9: Frequencies and percentages of TCK applied by teachers during the researcher's lesson observation (N=12 lessons)

Technological Content Knowledge (TCK)	Frequency	Percentages (%)
The teacher uses teaching materials to assess learners' prior knowledge. For example make use of a graph, image, audio, etcetera	3	27
For specific subject content presentations, the teacher created a variety of teaching and learning materials with ICT	7	58
The teacher created teaching and learning materials that are appropriate for the learners' mental abilities	7	58

4.4.6 Technological pedagogical knowledge (TPK)

The evaluation of teachers' use of TPK in the classroom revealed that only half of the participants (50%) use teaching and learning materials such as images, diagrams, quizzes, and audio for explanations and presentation of subject contents (Table 4.10). Findings also revealed that half of the participants created teaching and learning materials that are clear and visible and allow learners to participate (Table 4.10). The other half of the participants used chalkboards and handwritten materials for the explanation and presentation of the subject contents.

Table 4.10: Frequencies and percentages of TPK applied by teachers during the researcher's lesson observation (N=12 lessons)

Technological pedagogical knowledge (TPK)	Frequency	Percentages (%)
For explanations and presentations, the teacher employs teaching and learning materials such as images, diagrams, quizzes, audio records, etcetera	6	50
Created teaching and learning materials are clear as well as visible and allow learners to participate	6	50

4.4.7 Content knowledge (CK)

The evaluation of teachers' use of CK in the classroom revealed that the majority of participants (67 %) used ICT-created teaching and learning materials that matched subject content followed by the use of ICT-created teaching and learning materials such as diagrams, posters, worksheets, and videos to sum up main topics (Table 4.11). The least use of CK in the classroom was the use of

ICT tools including audio or video, speakers, pictures, and diagrams which were only used by 25 % of the participants.

Table 4.11: Frequencies and percentages of CK applied by teachers during the researcher's lesson observation (N=12 lessons)

Content Knowledge (CK)	Frequency	Percentages (%)
Created teaching and learning materials with ICT match with subject content	8	67
The teacher sums up the main topic with teaching learning materials (e.g. diagram, poster, worksheet, video, etcetera)	5	42
The teacher makes use of audio/video, speaker, pictures, diagrams, etcetera to provide feedback for challenging exercises	3	25

4.4.8 Pedagogical knowledge (PK)

The evaluation of teachers' use of PK in the classroom revealed that the majority of participants (83 %) created worksheets, handouts, tasks, and so on for the entire class, individuals, groups, and pairs (Table 4.12). Furthermore, only 25% of participants permitted prediction during the presentation process, according to the findings. This includes allowing learners to observe, watch, or listen to something, and then asking them to guess the topic (Table 4.12).

Table 4.12: Frequencies and percentages of PK applied by teachers during the researcher's lesson observation (N=12 lessons)

Pedagogical knowledge (PK)	Frequency	Percentages (%)
The teacher created worksheets, handouts, tasks, etc. for the whole class, individuals, groups, and pairs	10	83
The teacher allows prediction in the presentation process. For instance, allow learners to observe, watch or listen to something and ask the learners to guess the topic	3	25

4.4.9 Pedagogical content knowledge (PCK)

Only 42% of participants in the evaluation of teachers' PCK use in the classroom used it effectively by using a variety of teaching materials to make the subject matter understandable for learners (Table 4.13). It was also observed that most teachers only use textbooks to explain lesson topics with no additional ICT-created teaching materials used.

Table 4.13: Frequencies and percentages of PCK applied by teachers during the researcher's lesson observation (N=12 lessons)

Pedagogical Content Knowledge (PCK)	Frequency	Percentages (%)
The teacher makes use of a variety of teaching materials (posters, graphs, drawings, audio, videos, worksheets, etcetera, to make the subject content easy for learners	5	42

4.4.10 Technological pedagogical and content knowledge (TPACK)

The evaluation of teachers' use of TPACK in the classroom revealed that the majority of participants (53 %) used ICT to create typed and printed exercises, homework, topic tasks, and lesson plans (Table 4.14). In terms of giving feedback with appropriate ICT-created teaching and learning materials, only one (8%) participant made use of this strategy. Furthermore, it was observed that teachers do not use typed forms for recording and evaluations (Table 4.14). It was also observed that homework instructions were written on the chalkboard in all observed lessons.

Table 4.14: Frequencies and percentages of TPACK applied by teachers during the researcher's lesson observation (N=12 lessons)

Technological Pedagogical Content Knowledge (TPACK)	Frequency	Percentages (%)
The teacher gives feedback with appropriate ICT-based teaching and learning materials	1	8
Forms for recording evaluations that are typed	0	0
ICT is used to create typed and printed exercises, homework, topic tasks, and lesson plans	7	58

4.4.11 Summary of sub-research question one

The results show that participants had different levels of understanding of what ICT is with some referring to it as a source of information that includes media, communication tools, anything that is not a pen, and modern technological devices and teaching aids. Findings also indicated that all participants had used ICT tools in the creation of teaching and learning materials in a variety of ways with typing of learners' activities being the most common while the use of pre-recorded

lessons was the least common use of ICT tools. Furthermore, it was observed that the majority of participants were motivated by the fact that ICT motivates learners to learn and that ICT simplifies work, while the internet and mobile devices were the most frequently used ICT tools which were used by all participants, followed by computers. It was also observed that participants used a variety of ICT-created teaching and learning materials for the specific topic content presentation that is appropriate for learners' mental abilities. The evaluation of teachers' use of TPK in the classroom revealed that only half the number of teachers use teaching and learning materials such as images, diagrams, quizzes, and audio for explanations and presentation of subject contents. In addition, the present findings demonstrated that teachers only apply their CK well to create teaching and learning materials with ICT that matched subject content and PK to create worksheets, handouts, tasks, etc. The present study also found that although more than half of participants used TPACK when using ICT tools to type learners' activities, topic tasks, and lesson plans, the majority of participants did not use it when providing feedback during lessons or typing evaluation forms.

4.5 SUB-RESEARCH QUESTION 2: “WHAT CHALLENGES DO TEACHERS FACE WHEN DEVELOPING TEACHING AND LEARNING MATERIALS USING ICT?”

An interview with six teachers, two from each school was used to collect data on the challenges that teachers face when developing teaching and learning materials. This information was used to answer the second research question; “*What challenges do teachers face when developing teaching and learning materials using ICT?*” The research question was addressed through three items: challenges with the supply of ICT tools at school, challenges with IT support at school, and challenges for teachers in developing teaching and learning materials using ICT tools. This section presents the results of the three items.

4.5.1 Challenges with the supply of ICT tools at school

To assess teacher challenges related to the supply of ICT tools in schools, teachers were asked the following question: "*What challenges do you face in terms of ICTs supply at school?*". Six teachers provided answers which were analysed in ATLAS.ti version 22 qualitative research tool, where similar-sounding statements were given the same coded labels and their frequency of occurrence in all six responses was determined (Fig. 4.4).

According to the responses, the most common challenges faced by teachers were not enough ICT tools (computers, laptops, printers, copy machines, projectors) which are shared among teachers, shortage of electricity supply in the classroom, and poor weak internet connection in the classrooms, which was shared by all six teachers. Poor internet connectivity has been reported in classrooms, particularly in classrooms located far from administration buildings. Furthermore, it was found that the majority of the internet provided at schools was from a single service provider, and when their network signals weaken or go down, there were no other options for accessing the internet. This was confirmed by Teacher A, who stated:

"The internet connection is weak specifically in my class because it's far from the office and always affects the downloading of quality information. Another challenge is that we only have one internet that provided Paratus Namibia with no multiple internets like MTC or Telecom. This means that if the Paratus network is not working then we can't do anything." (Teacher A).

Teacher B expressed the same concern as Teacher A, saying;

"The challenge we have at school is a poor network. This means the internet covers a small area, it does not reach some classrooms special the one that is far from the administration building." (Teacher B).

Due to the challenge of not having good internet connections in some classrooms, some teachers have turned to their resources as an alternative. Teacher D claims that:

“Our internet is very slow but I always try to hotspot from my cell phone and at home I have Wi-Fi and do not struggle too hard.” (Teacher D).

Although most teachers indicated that there are printing facilities at schools, periodic ink shortages that take a long time to replace disrupt teachers' planned use of printers to print out teaching materials for learners. According to Teacher A:

“The other thing is that sometimes the printing ink finishes and is forced to do things manually.” (Teacher A).

Furthermore, while some teachers reported having access to ICT tools such as computers, projectors, radios, etcetera, these tools were reported to be inadequate. Teacher C expressed this by saying:

“The challenges I face at school in terms of ICTs supply are that there is a need for computers, laptops, printers, radios, and speakers. And there is no overhead projector or whiteboard.” (Teacher C).

In addition, Teachers D, E, and F also expressed the same view on the lack of adequate ICT tools:

“The challenge we have at moment in terms of ICT supply is that there are not enough computers, laptops, radios, speakers, a projector, and printers. In my case, everything I use belongs to me except the printer and photocopy machine.”
(Teacher D).

“There is only one computer in the office for all the teachers that are connected to the internet and this computer is always occupied.” (Teacher E).

“There is only one printer and only accessible to the secretary, most of our work gets delayed because if she happens not to be at work we have to wait until she is back.” (Teacher F).

Lack of adequate ICT tools in schools was shared by five teachers (Fig. 4.4). The third most common ICT supply-related challenge experienced by teachers was a periodic shortage of printing ink, which was shared by three teachers, followed by a shortage of electricity in the classroom, which was shared by one teacher (Fig. 4.4).

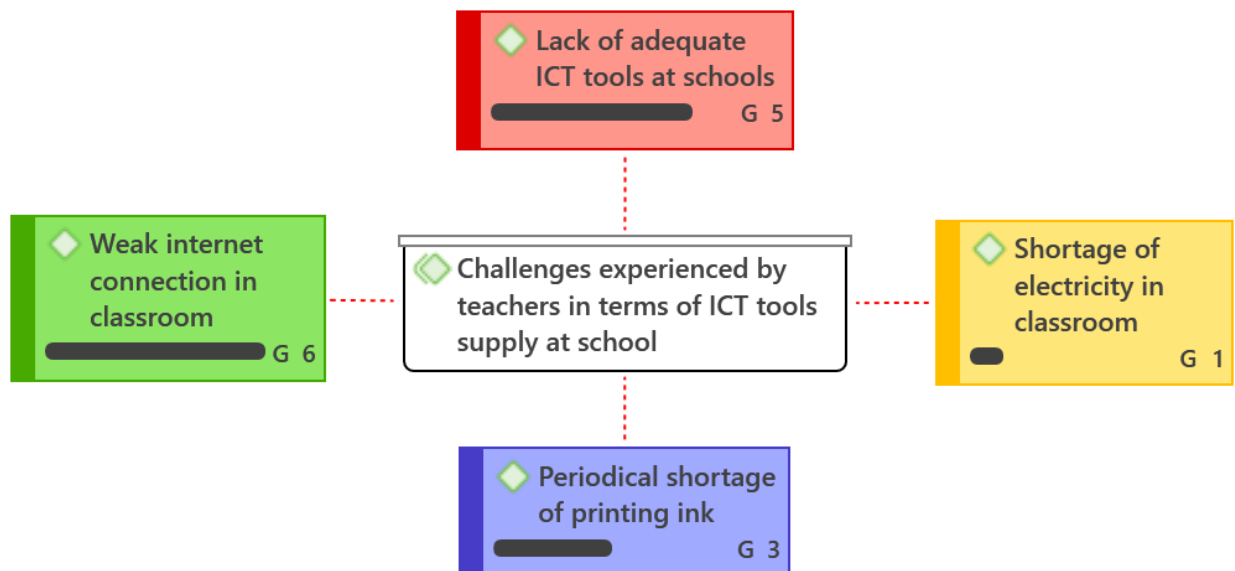


Figure 4.4: Identified ICT supply-related challenges experienced by teachers at schools.

In this figure, G represents the frequency of occurrence of the statement in participants' responses.

4.5.2 Challenges with IT support at school

To assess teacher challenges related to IT support at schools, teachers were asked if they had any challenges with ICT support in their respective schools. Six teachers provided answers which were analysed in ATLAS.ti version 22 qualitative research tool, where similar-sounding statements were given the same coded labels, and their frequency of occurrence in all six responses was

determined (Fig. 4.5). Participants identified two common ICT support challenges faced by teachers: a lack of IT technicians in schools, which was shared by all six teachers, and a lack of funds, which was shared by three teachers (Fig 4.5).

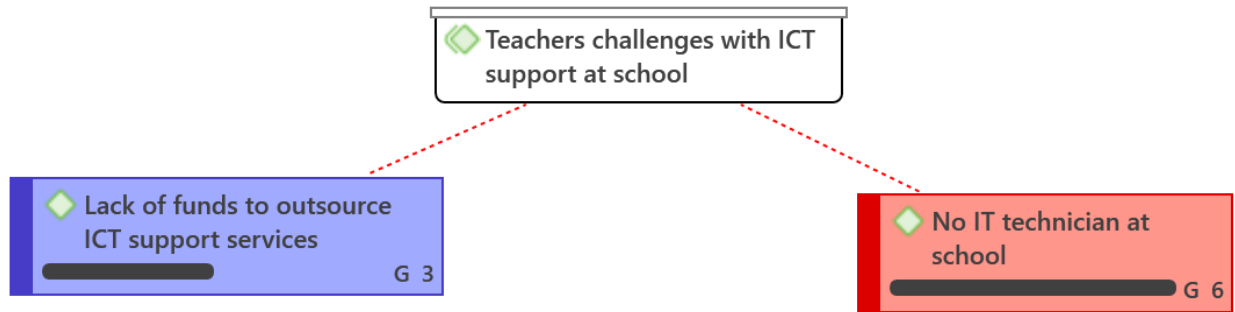


Figure 4.5: Identified ICT support-related challenges experienced by teachers at schools. G represents the frequency of occurrence of the statement in participants' responses.

According to the findings of the study, lack of technical support harmed the quality of teaching and learning. Teacher D has explained that:

“There are some days whereby the printing machine does not want to function then we have to wait for days to be fixed. Sometimes this delays our work and frustrating at the same time. This applies also to the computer that is accessible by a teacher there is a point that needs to be updated because starts freezing and load very slowly. And because it is used by every teacher sometimes our USB gets viruses and information gets lost.” (Teacher D).

Other teachers also shared the same concern regarding the lack of ICT support at their respective schools regarding the maintenance of computers, printing machines, and the internet. In addition, participants in this study indicated that the schools do not have enough money to hire, technicians. For instance, Teacher E stated:

“The school does not have enough money to hire someone to come and fix computers, therefore six computers at the school were not been fixed for a long time.” (Teacher E).

Furthermore, Teacher F who was from the same school as Teacher E indicated that there were computers in the school’s computer lab that were not fixed for more than a year. Lack of ICT support causes teachers to do their duties using just chalkboards and textbooks, occasionally using their own resources.

4.5.3 Challenges for teachers in developing teaching and learning materials using ICT tools

Teachers' difficulties in developing teaching and learning materials using ICT tools were investigated through interviews in which six participants were asked to identify challenges they faced when developing teaching and learning materials. Similar-sounding responses were given the same coded labels in the ATLAS.ti version 22 qualitative research tools and the frequency of their occurrence in all six responses were provided (Fig 4.6). The results indicated that poor internet network connection, which was experienced by four participants, emerged as the most prevalent challenge faced by teachers when creating teaching and learning materials (Fig. 4.6). The second most frequent challenges were interruptions in the supply of electricity, a lack of adequate ICT tools, a lack of internal training, and recurring printing ink shortages, which were shared by three participants. According to Teacher A:

“Whenever I experience a problem while working on the ICT tools to creat, my teaching materials I only approach my colleagues but sometimes they also do not have an idea on to go about it. Such a problem always hinders my work.” (Teacher A).

“Although I went through some computer training, I still experience challenges whenever creating some teaching and learning materials. This is because I attended this training a long time and many things have changed. Sometimes I struggle to insert a picture and write on it and I end up writing with a pen.”
(Teacher C).

“The advancement of ICTs requires also new skills. As mentioned early that I only received basic, sometimes technology fails me, and if no one has that skill at school and no expertise I end up giving up everything.” (Teacher E).

Furthermore, one participant identified a lack of IT technicians at school as a factor influencing teachers' development of teaching and learning materials (Fig. 4.6).

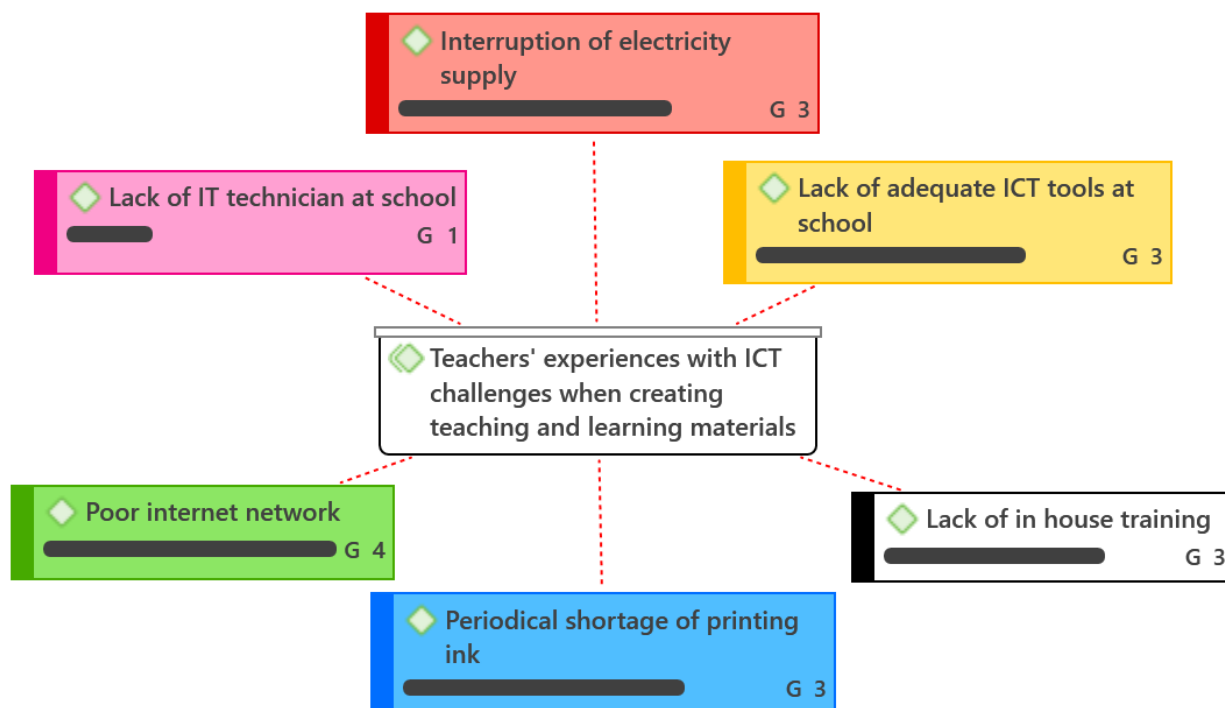


Figure 4.6: ICT challenges encountered by teachers when developing teaching and learning materials. G represents the frequency of occurrence of the statement in participants' responses.

4.5.4 Summary of sub-research question two

The findings showed that poor internet connection in classrooms was the most frequent issue that teachers encountered while creating teaching and learning materials. Additionally, participants mentioned that they occasionally struggled to get the essential information for preparation because of their bad connectivity. Furthermore, it was highlighted that teachers also reported challenges due to a lack of IT technicians in schools and a lack of funding. This came about as a result of the participants' disclosure that occasionally computers, laptops, the internet, and printers break down and need a technician to be maintained, which costs money that the schools must have available to hire a technician. The results also showed that teachers need to receive training to use ICTs effectively. Finally, despite schools having two or three ICT tools that are shared among the teachers, the researcher noticed a shortage of these resources.

4.6 CHAPTER SUMMARY

This chapter discussed findings from data collected through interviews and field observation to answer two research questions: (1) “How do teachers apply their ICT knowledge to create teaching and learning materials for their classrooms?” and (2) “What challenges do teachers experience in creating teaching and learning materials using ICT?” The study focused on three schools in a remote area of the Khomas region, Namibia. Therefore, the findings of this study as presented in this chapter answered the research questions, which implies the achievement of the study’s main objective. The data was analysed in ATLAS. ti version 22 and tables were done in Microsoft Word, 2016.

The study found that the participants' comprehension of ICT varied greatly. The results also showed that all participants had previously utilised ICT technologies to create teaching and learning materials. Additionally, it was noted that the majority of participants were inspired by

how ICT facilitates work and promotes learning. Participants were seen utilising a variety of ICT-created teaching and learning resources for the presentation of a particular topic's content. The current study furthermore discovered that although more than half of participants used TPACK when utilising ICT tools to type learners' activities, topic tasks, and lesson plans, the majority of participants did not use it when delivering feedback during classes.

Regarding the second sub-research question, the results showed that teachers encountered several difficulties, such as poor connectivity of the internet in the classroom, a lack of IT technical support, maintenance budgets, sufficient ICT equipment, and training when creating teaching and learning materials. The discussion of the research's findings is included in the following chapter.

CHAPTER FIVE: DISCUSSION OF FINDINGS, RECOMMENDATIONS, AND CONCLUSIONS

5.1 INTRODUCTION

This chapter presents a discussion of findings from the present study on teachers' creation of teaching and learning materials using ICT at selected remote schools in the Khomas region of Namibia. Findings from two research questions of this study were summarised to answer the main research question which was: “What are teachers’ knowledge and understanding of the value of creating teaching and learning with ICT?” Therefore, in this chapter findings are contrasted and compared with those of relevant previous studies.

5.2 MAIN RESEARCH QUESTION ANSWERED: TEACHERS’ KNOWLEDGE AND UNDERSTANDING OF THE VALUES OF CREATING TEACHING AND LEARNING MATERIALS WITH ICT

The primary research question for this study addressed teachers’ knowledge and understanding of the values of creating teaching and learning materials with ICT. This study discovered that teachers' comprehension of ICT varied greatly in the Khomas region's remote schools. The majority of participants found it encouraging to use ICT tools as they make teaching materials appealing to learners, thereby boosting performance, and offering up-to-date materials. This result is consistent with that of Pedagoo (2020), who discovered that teachers can access cutting-edge learning materials that engage learners in the subject being taught and inspiring them through the use of ICT tools. Additionally, findings revealed that schools have ICT tools such as computers, printers, photocopy machines, projectors, the internet, and electricity. This indicates that educational institutions have ICT resources that are available for use by teachers in the creation of learning materials. Furthermore, the findings showed that participants used ICT tools to create a variety of teaching and learning materials. This includes lesson preparations, downloading videos

and pictures, recording audios, and typing learners' activities being the most common. These findings agree with those of Bhalla (2013), who states that teachers at the central school in India use ICT tools like computers and laptops to keep up with subject knowledge and teaching techniques, create lesson plans, and obtain the necessary additional teaching and learning resources like posters, handouts, and books which are available on the internet. In the current study, the researcher observed that a few teachers use ICT as storage tools for teaching and learning materials. Therefore, teachers need to be encouraged to make use of ICT tools for information storage to increase their work efficiency.

This study also discovered that teachers had difficulties using ICT tools in schools due to inadequate supplies. This is evident from the number of ICT tools such as computers, projectors, printers, and photocopiers available in the schools, with the majority ranging from one to three per school. The lack of ICT tools in schools is attributed to several factors, including a lack of capital to purchase the tools and a lack of infrastructures such as secure school buildings and electricity as shared by participants. Tendane and Amukeshe (2022) reported a similar challenge that at least 1300 out of 1800 public schools in Namibia do not have basic technological infrastructures including computers, internet connections, and telephone lines. Additionally, the study found that teachers' usage of ICT tools to create teaching and learning materials is affected by the availability of IT professionals, ICT support, poor network, and school maintenance. Inadequately handled equipment problems could hinder teaching and demoralise the teachers. The findings also revealed that schools occasionally lack the finances to compensate technicians because some schools do not have ICT budgets. The level of teachers' proficiency with ICT tools was also found to have an impact on the use of ICT tools in developing teaching and learning materials in schools in this study. Although some teachers obtained computer training and Continuous Professional

Development (CPD), Matengu (2006) suggests that technical staff training still needs to be increased. Furthermore, it was noted that acquiring the most recent information was difficult at school due to poor internet connectivity. The internet is very important as it provides a wide range of educational materials and opportunities for knowledge exchange, including but not limited to audio, video, and visual content (Waiganjo & Paxula, 2020). This leads to the conclusion that while some schools have facilities for ICT tool supply and some teachers use these tools, most schools still face significant challenges regarding the accessibility of ICT tools and a lack of skills to use them effectively.

5.3 MATCHING FINDINGS FRAMEWORK (TPACK)

The main focus of this study was on teachers' knowledge about the use of ICTs in the creation of teaching and learning materials by connecting them to TPACK. According to Niess (2011), TPACK is a framework that describes the knowledge that teachers need to develop, implement, and evaluate teaching methods using technology. Therefore, this framework offers an interrelated strategy that enables teachers to use their skills while creating teaching and learning materials. The seven components of TPACK were created through the interaction of the three (content, pedagogy, and technology) fundamental types of knowledge: technological knowledge (TK), content knowledge (CK), pedagogical knowledge (PK), pedagogical content knowledge (PCK), technological content knowledge (TCK), and technological pedagogical knowledge (TPK). The findings of the use of TPACK components linked to ICT in the creation of teaching and learning in this study are discussed below.

5.3.1 Technological knowledge (TK)

Teachers' TK assessments revealed that despite teachers' claims that all schools had ICT tools and most of the teachers indicated that received computer training at their universities, the study also discovered that even though schools have ICT tools, those resources are insufficient and they were shared. Tendane and Amukeshe (2022) reported the same thing, stating that only 1300 of Namibia's 1800 public schools had ICT infrastructure. The researcher also observed that participants used very little ICT-created materials practically in the introduction of lessons. According to Lupascu et al. (2014), teachers' lesson preparation, which includes a lesson introduction, is essential for the lesson's effectiveness. Furthermore, Milkova (2012) asserts that using short videos and other creative approaches to lesson introduction could help to boost learners' interest and encourage learners' participation. It is therefore concerning that most teachers do not use ICT tools to create teaching and learning materials for introducing lessons to learners. Therefore, teachers need to be empowered through continuous professional development (CPD) to keep up with modern teaching methods to improve lesson effectiveness. Furthermore, the study found that teachers had different levels of ICT knowledge and its application in the creation of teaching and learning materials. Moreover, some teachers indicated that they face the challenge of technical ICT support particularly when it comes to the use of computers to create teaching materials. This is an indication that teachers do not get sufficient ICT training at universities.

5.3.2 Content knowledge (CK)

The present findings demonstrated that teachers only apply their CK well to create teaching and learning materials with ICT that matched subject content. Content knowledge refers to the knowledge of teachers about the subject content that is taught to learners (Koehler & Mishra,

2009). According to Shulman (1986), CK includes an understanding of concepts, paradigms, ideas, organisational strategies, understanding of factual evidence, and established processes and methods for acquiring such information. Furthermore, the present study revealed that teachers used CK poorly to conclude lessons using ICT-created materials and ICT tools to provide feedback for challenging exercises to learners. This implies that participants preferred to use ICT-created materials that matched subject content more than other methods. Therefore, teachers need to be encouraged to diversify their use of CK.

5.3.3 Pedagogical knowledge (PK)

The present findings demonstrated that teachers only apply their PK well to create worksheets, handouts, tasks, etcetera for the whole class, individuals, groups, and pairs. According to Koehler et al. (2007), pedagogical knowledge refers to the techniques, procedures, or practices required for teaching and learning. PK covers subject-matter presentation techniques and teaching strategies for meeting individual learners' needs (Kanuka, 2006). Therefore, it is evident that teachers in the three remote schools in the Khomas region teach in a traditional pedagogy and seldom apply teaching strategies of using ICT-created materials to teach. The study revealed that teachers used PK poorly during the lesson presentation process, particularly in terms of allowing learners to observe, watch or listen to ICT-created materials and guess the topic. This implies that teachers do not use their PK knowledge to allow lesson interaction with learners. The reason why teachers do not use PK in the classroom can be attributed to a lack of awareness of the topic and a lack of adequate ICT tools at schools.

5.3.4 Pedagogical content knowledge (PCK)

Pedagogical content knowledge involves the transformation of the subject content that occurs when the teacher interprets subject content and finds different ways to present it, including the use of teaching materials (Shulman, 1986). The present study revealed that most teachers do not use a variety of teaching materials to simplify subject content. This suggests that the usage of ICT resources at the schools taken into consideration for this study has not resulted in any transformation of subject content. This predicament needs to be changed through the training and motivation of teachers.

5.3.5 Technological content knowledge (TCK)

The present study revealed that teachers use TCK to create a specific topic content presentation that is appropriate for learners' mental abilities. Technological content knowledge refers to knowledge of how content and technology interact and impact one another (Koehler & Mishra, 2009). Thus, good TCK for teachers is reflected in their understanding of how specific technologies can change the subject matter. The present findings demonstrate that teachers apply their TCK poorly to assess learners' prior knowledge of the subject matter during lessons. However, present findings revealed that teachers were more proactive when it comes to the use of appropriate ICT-created materials to present subject content. Though there are some encouraging signs regarding the use of teachers' TCK in the creation of teaching and learning materials, much work remains to be done to improve the effectiveness of this practice.

5.3.6 Technological pedagogical knowledge (TPK)

Technological pedagogical knowledge is an understanding of how technology can change teaching and learning when used in various ways (Koehler & Mishra, 2009). Sahin (2011) adds that TPK

is the merger of ICT tools with effective teaching methods and strategies while acknowledging its advantages and disadvantages. The present findings demonstrated that teachers apply their TPK fairly to explain and present subject contents using ICT-created teaching and learning materials such as images, diagrams, quizzes, and audio amongst others. Similarly, present findings revealed that teachers used their TPK to develop teaching and learning resources that are transparent, appealing, and encourage student participation. This implies that teachers in the present study fairly merged ICT tools with effective teaching methods as explained by Sahin (2011). However, with only 50 % of the teachers employing this strategy, it indicates that there is a need to motivate teachers to do more. This can be achieved by increasing the ICT supply at schools and through continuous professional development.

5.3.7 Technological pedagogical content knowledge (TPACK)

The findings revealed that the majority of participants have the knowledge and skills that are necessary to use technology to create teaching and learning materials. The researcher observed that learners' activities (exercises, home works, topic tests, and investigations) were typed and printed. The study also found that teachers are knowledgeable and proficient in the subject since the materials that teachers have created are relevant and appropriate for the subject matter. The study further revealed that teachers employed several instructional strategies to support learners in comprehending the subject matter. Although the current study discovered that more than half of participants utilised TPACK when employing ICT tools to write learners' activities, topic tasks, and lesson plans, the majority of participants did not use their TPACK when offering feedback during lessons or typing evaluation forms. This suggests that there is not enough interaction between content, pedagogy, and technology knowledge in the planning and delivery of lessons.

5.4 LIMITATIONS OF THE STUDY

The present study was based on a case study of three schools in a remote area of the Khomas political region. As a result, the current findings might not accurately represent the situation that exists in schools in other regions of the country. The schools were chosen based on their low socioeconomic conditions. These are under-resourced schools that are located in less-populated remote areas and have poor infrastructure and access to basic needs, all of which hurt teacher and student performance. For comparison, more schools, particularly those in urban areas, could have been considered. However, this could not be explored due to the time and scope of the study. Furthermore, the present study dedicated the methodology approach to qualitative data. Quantitative data could also complement the qualitative data collected for this study to answer more research questions and get a broader understanding of the subject matter. However, due to the scope of this study, the data collected was sufficient to answer all research questions. The data gave an insight into the teachers' ICT knowledge and challenges faced in creating teaching and learning materials in remote schools located in the Khomas region. According to Simon (2014), to get a broader understanding of teachers' use of ICT, teachers' attitudes and knowledge need to be thoroughly evaluated. In this study, the knowledge component was addressed.

5.5 RECOMMENDATIONS FOR PRACTICE

This study focused on research questions to determine teachers' creation of teaching and learning materials using ICT at selected remote schools in the Khomas region, Namibia. During this study, the literature was reviewed, which aided in the formulation of recommendations. As a result of the findings and the literature review, the researcher makes the following suggestions:

- Remote schools in the Khomas region should be supplied with adequate ICT tools such as computers, printers, and photocopiers to allow teachers full-time access to these tools. This

is because most schools have only one computer that is shared amongst all teachers at the school. Similarly, other ICT tools including printers, photocopiers, and overhead projectors are shared by all teachers at school which constrains teachers' time spent on the tools.

- From the literature, it was found that only 500 out of 1800 public schools in Namibia had basic technological infrastructures that included computers, internet connections, and telephone lines. Therefore, it is recommended that the Ministry of Education, Arts, and Culture provides provisions for all public schools to be supplied with these infrastructures to optimise the use of ICT in schools.
- It was also found that some classrooms do not have an electricity supply, thereby making it impossible for teachers to make use of ICT tools. Therefore it is recommended that the provision for electricity supply be made to all schools and classrooms.
- It was found that some teachers have limited knowledge of how to use specific ICT tools. Therefore, teachers need to be empowered through continuous professional development (CPD) to keep up with modern teaching methods to improve lesson effectiveness.
- The internet connection needs to be upgraded for it to be a bit faster and cover a large area as it only reaches some classrooms.
- There is a need for the government to employ full-time IT technicians to provide technical support to teachers as well as for the maintenance of ICT tools or equipment.
- The government should budget funds for the maintenance acquisition of ICT consumables such as printing ink and ream papers. This is because some of these consumables take too long to be replaced or resupplied.

5.6 RECOMMENDATIONS FOR FUTURE RESEARCH

The present study had limitations that can be addressed in future studies; therefore the researcher recommends the following for future research:

- The present study only focused on three schools in remote areas located in the Khomas region and the present findings may not reflect the present situation in schools located in other parts of the country. Therefore, future studies can focus on other parts of the country to have a broader understanding of the subject matter.
- The schools covered in this study were from remote areas and the research did not cover schools in urban areas. Therefore, future studies can cover more schools to allow comparability between rural and urban schools.
- The present study employed a qualitative research design. Furthermore, the present study selected schools and participants using a purposive sampling method. To address the subject matter, future studies can investigate other research methods such as quantitative with randomised sampling designs.
- Future studies can also look at the effects of teachers' attitudes on the use of ICT tools in creating teaching and learning materials.

5.7 CONCLUSION

The study's goals were to investigate how teachers used their knowledge and to identify the challenges of creating instructional materials for rural schools in the Khomas Region. Consequently, the knowledge acquired is beneficial to the Ministry of Education, notably to managers and curriculum developers for considerations regarding future ICT advances in the Namibian education sector. The study's results are also helpful for teacher education institutions in evaluating their ICT integration curricula and enhancing pre-service teachers' technical literacy.

The study focused on three schools in the Khomas Region's remote area, where six teachers, two from each school, were chosen to participate to answer the research questions.

On teachers' ICT knowledge in creating teaching and learning materials for classrooms, it was concluded that teachers in schools located in the remote area of the Khomas region had good knowledge of the use of ICT tools which they use to type learners' activities, download teaching and learning materials from the internet, print materials and projection of lesson contents in classrooms. Furthermore, this study concludes that teachers face various challenges in creating teaching and learning materials including weak internet connections in the classrooms, lack of adequate ICT tools, periodic shortage of printing ink, no electricity in classrooms, lack of IT technicians, and lack of funds. These findings contribute to the pool of knowledge on the use of ICT tools in the creation of teaching and learning materials for classrooms in the Namibian context. Future teacher training curricula must emphasise the teacher's teaching materials which are developed as part of the ever-changing pedagogical strategies for teachers and to engage learners more.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE CERTIFICATE


UNAM
UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: WKC0003

Date: 03 April 2022

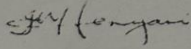
This Ethical Clearance Certificate is issued by the University of Namibia Decentralized Ethics Committee (DEC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the **School of Education (Windhoek & Khomasdal Campuses) Decentralized Ethics Committee**.

Title of Project: Teachers creation of teaching and learning materials using ICT at selected remote schools in the Khomas region.
Researcher: Eveline Ndakolo
Student number: 201120194

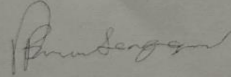
Take note of the following:

1. Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the ethics committee. An application to make amendments may be necessary.
2. Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the ethics committee
3. The Principal Researcher must report issues of ethical compliance to the ethics committee (through the Chairperson) at the end of the Project or as may be requested by the ethics committee
4. The ethics committee retains the right to:
 - i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,
 - ii) Request for an ethical compliance report at any point during the course of the research.

The ethics committee wishes you the best in your research.

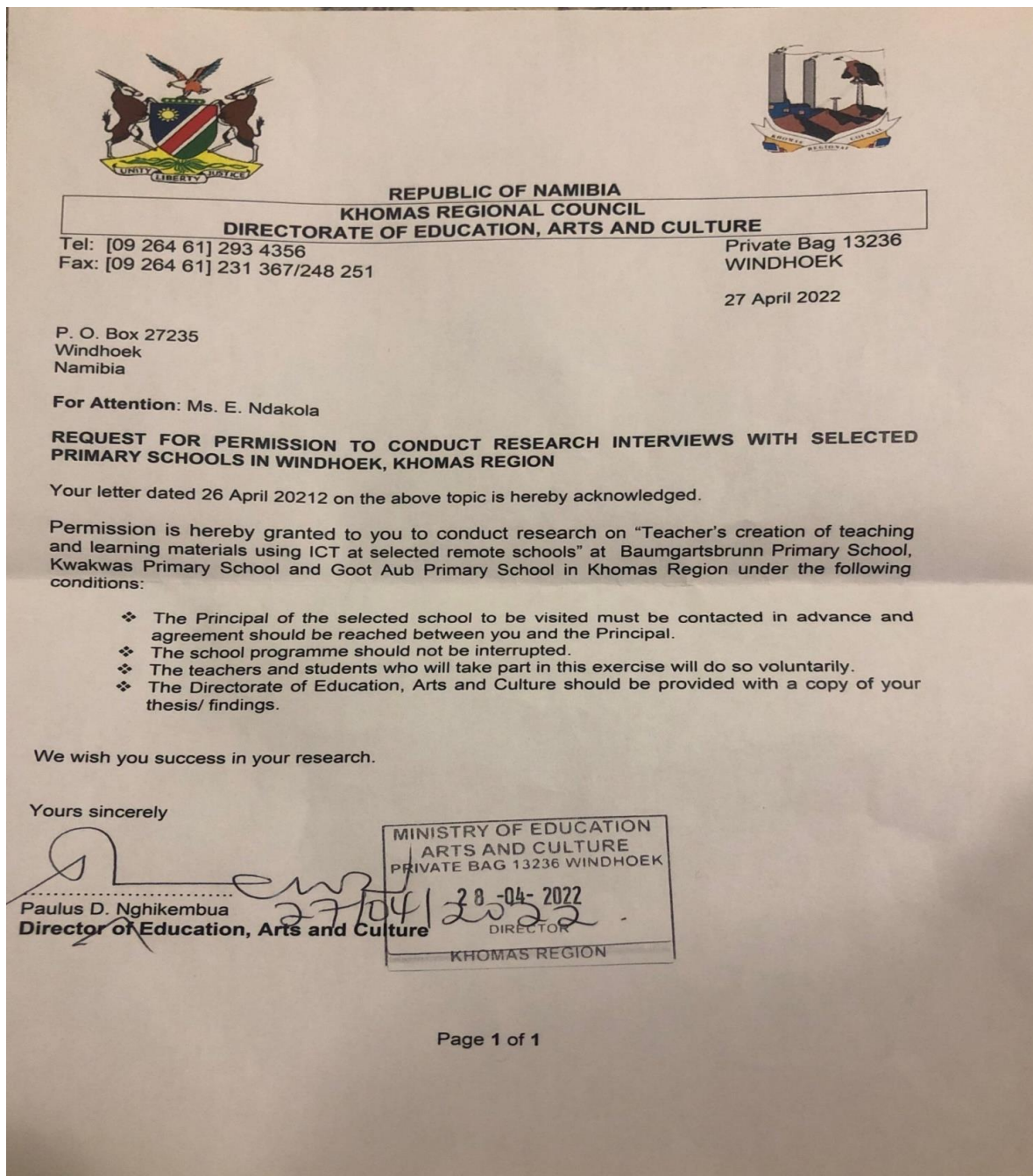


Dr. Job U. Hengari (Chairperson, Windhoek & Khomasdal Campuses DEC)



Prof. Davis Mumbengegwi (Head, Multidisciplinary Research)

APPENDIX B: APPROVAL TO CONDUCT RESEARCH AT SCHOOLS BY MoE



APPENDIX C: CLASSROOM OBSERVATION CHECKLIST

Introduction

To investigate the application of teachers' ICT knowledge and to understand the challenges surrounding teachers' creation of teaching and learning materials using ICT, especially in remotely located schools, the researcher carried out nonparticipant classroom observation that was purely focused on (TPACK) Technological Pedagogical Content Knowledge.

1. Classroom observation schedules for teachers

Background information	
Code of the classroom	
Code of the teacher	
Observer's name	
Date	
Grade	
Theme and Topic	
Time	

Component: Technological Knowledge (TK)			
Activity: ICT tools available in the classroom			
	Yes	No	Comments
Computer/ laptop			
Radio			
Speaker			
Overhead projector			
Smartboard			
Internet			
Interactive whiteboard			
Mobile devices (example, personal cell phone)			
Activity: Teaching and learning materials created with ICT are available in the classroom			
Posters are designed with ICT (using Microsoft Word, Adobe, etcetera)			
Texts on the poster are typed (Microsoft Word)			
Teaching and learning materials are printed and cut out			
Different font colours are used on teaching and learning materials			
An appropriate font size is selected for the learners			

Handouts, pamphlets, study guides, etcetera are prepared using a computer			
Relevant graphs, charts, books, and diagrams are created using ICT (Microsoft Word, Spreadsheets).			
Activity: Lesson Presentation			
An appropriate introduction (teacher uses teaching and learning materials created with ICT).			
	YES	NO	Comments
Graphs			
Charts			
Posters			
Drawing			
Audio recorder			
Video recorder			
Component: Technological Content Knowledge (TCK)			
The teacher uses teaching materials to assess the learners' prior knowledge. for example making use of a picture, graph, image, audio, etcetera			
For the specific subject content presentation, the teacher created a variety of teaching and learning materials with ICT			
The teacher creates teaching and learning materials that are appropriate for the learners' mental abilities			

Component: Technological pedagogical knowledge (TPK)			
For explanations and presentations, the teacher employs teaching and learning materials (such as images, diagrams, quizzes, audio records, etcetera)			
Created teaching and learning materials are clear as well as visible and allow learners to participate			
Component: Content Knowledge (CK)			
Created teaching and learning materials with ICT match with subject content			
The teacher sums up the main topic with teaching and learning material. (For example with diagram, poster, worksheet or video, etcetera)			
The teacher makes use of audio/video, speaker, pictures, diagrams, etcetera to provide feedback for challenging exercises			
Component: Pedagogical Knowledge (PK)			
The teacher created worksheets, handouts, tasks, etc. for the whole class, individuals, groups, and pairs			
The teacher allows prediction in the presentation process. For instance, allow learners to observe/watch/listen to something and ask the learners to guess the topic			
Component: Pedagogical Content Knowledge (PCK)			

The teacher makes use of a variety of teaching and learning materials (posters, graphs, drawings, audios, videos, worksheets, handouts, etcetera to make the subject content easy for the learners.			
Component: Technological pedagogical content knowledge (TPACK)			
The teacher gives feedback through the use of appropriate ICT-based teaching and learning materials			
Forms for recording evaluations that are typed			
ICT is used to create exercise/homework/topic task/lesson plans, which are typed and printed off			

APPENDIX D: INTERVIEW GUIDE FOR TEACHERS

Introduction

The interview will be conducted only for research. The information gathered will be kept completely private and anonymous. Furthermore, your school has been chosen to participate in this study to provide information on how teachers use ICT to create teaching and learning materials, as well as the challenges they face when doing so. The interview will be 35 minutes long. There are no rights or incorrect answers; all responses will be greatly valued.

Section A: Biographical information

Questions	Indicators
<ol style="list-style-type: none">1. At which institution did you attend your education training?2. What is your highest teaching qualification?3. How long have you been teaching professionally?4. What are your present responsibilities at school?	Self-confidence

Section B: Interview (A semi-structured interview will be conducted)

Component: <i>Teachers' knowledge of using ICT to create teaching and learning materials</i>	
Questions	Indicator
1. How would you define Information Communication and Technology (ICT)?	Knowledge of technology tools
2. Do you have ICT tools at school? If yes, mention them	Computers/ laptops, tablets, internet or scanner, etcetera
3. How do you make use of ICT tools to create teaching and learning materials	Faster, easy

4. How would you describe your knowledge/ abilities to use ICT to create teaching and learning materials for your classroom?	Knowledge of technology tools and operations.
5. What specific example can you tell in which you have used ICT to create teaching materials?	Proof of posters, graphs, charts, pictures, etc. created and printed out.
6. What motivates you to use ICT tools?	Teacher belief and attitude
7. What is the role of ICT in creating teaching and learning materials?	Avail information
<i>Component: Challenges teachers' experience</i>	
8. What challenges do you face in terms of ICTs supply at school?	No computers, laptops, interactive whiteboard, etc.
9. Do you have any challenges with ICT support in your school?	No technician
10. What challenges are you facing as a teacher that may prevent you from creating teaching and learning materials using ICT?	No equipment and - Unqualified
11. What might assist you in making better use of ICT to create teaching and learning materials?	More types of equipment

APPENDIX E: LETTER TO THE SCHOOL PRINCIPALS

Eveline N Ndakolo

P.O. Box 8370

Bachbrecht, Windhoek

09 May 2022

The school principals

Khomas Regional council

Directorate of Education, art, and culture

Private bag

Windhoek

To whom it may concern

Re: Request for permission to conduct research at: _____

My name is Eveline Ndakolo, and I am a Master's degree student at the University of Namibia (UNAM). I wish to conduct my Master thesis titled "Teachers' creation of teaching and learning materials at remote schools in the Khomas Region" at your school. This research requires me to observe lessons and interview teachers in the senior primary phase (Grades 4-7) for two days. The collection of this data will be conducted from 16-23 May 2022. This research will be conducted under the supervision of Dr Simon and Dr Boer.

This letter serves to seek formal consent to approach the teachers who will be participants in this research. For this reason, I request your permission to conduct my research at your school.

I attach a letter of ethical approval from the Ethics Committee of the Faculty of Education and a letter from the Director of Education in the Khomas region. As part of this, I undertake to ensure that the school and participants will be replaced with pseudonyms and that all materials I collect as part of the research will be accessible only to myself and my supervisor.

Upon completion of the study, I undertake to provide you and the teachers with access to the research findings. If you require any further information, please do not hesitate to contact me on +264 813123846 and at ndakolon@gmail.com

Thank you for your time and consideration in this matter.

Yours sincerely

Eveline Naapopye Ndakolo

Student number: 201120194

University of Namibia (UNAM)

APPENDIX F: LETTER FROM THE EDITOR

ACET Consultancy

Aneyasha Communication, Editing and Training

Box 50453 Bachbrecht, Windhoek, Namibia

Cell: +264814218613

Email: mlambons@yahoo.co.uk / nelsonmlambo@icloud.com

30 October 2022

To whom it may concern

LANGUAGE EDITING – EVELINE N. NDAKOLO

This letter serves to confirm that a **MASTER OF EDUCATION (EDUCATIONAL TECHNOLOGY)** thesis entitled *TEACHERS' CREATION OF TEACHING AND LEARNING MATERIALS USING ICT AT SELECTED REMOTE SCHOOLS IN THE KHOMAS REGION, NAMIBIA* by Eveline N. Ndakolo was submitted to me for language editing.

The thesis was professionally edited and track changes and suggestions were made in the document. The research content or the author's intentions were not altered during the editing process and the author has the authority to accept or reject my suggestions.

Yours faithfully



DR NELSON MLAMBO

PhD in English

M.A. in Intercultural Communication

M.A. in English

B. A. Special Honours in English – First class

B. A. English & Linguistics