

ASSESSING MATHEMATICS TEACHERS' INTEGRATION LEVELS OF
INFORMATION AND COMMUNICATION TECHNOLOGY: A CASE OF
ONGHA CIRCUIT, OHANGWENA REGION

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ABSTRACT

A study titled "Assessing mathematics teachers' integration levels of information and communication technology: A case of Ongcha circuit, Ohangwena region" assessed the level of ICT integration of the secondary school mathematics teachers at MCA schools in Ohangwena Region. The study used the SAMR model to rank the level of secondary school mathematics teachers. A total sample of six (6) secondary school mathematics teachers at MCA schools was purposefully selected. The study uses qualitative methods to draw data from the participants. The study also utilized observations and a standardized interview with open-ended questions. Sample data collected from observations and interviews was subjected to an interpretive approach. Teachers' levels of ICT integration were ranked using the SAMR Ranking. Data recorded during interviews was transcribed verbatim and categorized under themes. The study revealed that the secondary school mathematics teachers do integrate ICTs into their teaching of mathematics at the substitution and augmentation levels of the SAMR model. The study further revealed in-service training, time to integrate ICT, provision of ICT tools and internet coverage, as well as technological support as challenges to the ICT integration in their teaching of mathematics at the secondary school level. The study recommends that the MoEAC provide guidelines for ICT integration and make IC a promotional subject to facilitate teaching delivery. The study further recommends that MoEAC provide funds for teachers' in-service training on the integration of ICT in teaching and learning processes in all subjects. Furthermore, the study recommends that further research to focus on assessing the teachers' level of ICT integration in teaching mathematics at MCA schools at a national level.

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This thesis is dedicated to my loving husband Gabriel Haileka and my lovely daughter Natalia Omwene-Tulela Gabriel. I dedicate this thesis to them for their patience, love and encouragement during the whole time that I stole from them as I was carrying out this study.

DECLARATION

I Ferdina Pomwene-Pawa Albinus, hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for a degree at any other institution.

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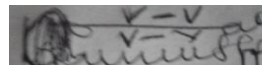
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October 2023

ACRONYMS AND ABBREVIATIONS

CAL	: Computer Assisted Learning
CESC	: Computer Education Community Services
ELF	: English Foreign Language
ETSIP	: Education and Training Sector Improvement Programme
GeSci	: Global e-School Initiative
GRN	: Government Republic of Namibia
GTML	: Generative Model of Multimedia Learning
HOD	: Head of Department
ICDL	: International Computer Driving License
ICT	: Information and Communication Technology
ICTED	: Information and Communication Technology for Education
MCA	: Millennium Challenge Account
MCC	: Millennium Challenge Corporation
MoEAC	: Ministry of Education Arts and Culture
NETA	: Namibia Education Training Academy
NETSS	: Namibian Education Technology Support Services
SAMR	: Substitution Augmentation Modification Redefinition
SPSS	: Statistics Package for Social Scientists
TAM	: Technology Acceptance Model
TRCs	: Teachers resource Centres
UNAM	: University of Namibia
UTAUT	: Unified Theory of Acceptance and Use of Technology
ZPD	: Zone of Proximal Development

CHAPTER ONE: INTRODUCTION

1.1 Introduction

This chapter introduces a study that assessed mathematics teachers' level of ICT integration using a SAMR model, a case study of MCA schools in Ohangwena Region. The chapter begins with a discussion of the background of the study and presents the statement of the problem, the research questions, the significance of the study, its limitations, as well as the delimitations. The definitions of the key terms used in the study, the outline of the study, as well as the chapter summary, are presented towards the end of this chapter.

1.2 Background of the study

ICT is another fundamental skill in the Namibian basic education curriculum (MoEAC, 2016). It is expected that all study areas should gradually develop essential abilities to help students comprehend how technological systems are part of social systems and the usefulness of ICT. Therefore, the Namibian government has added Basic Information Science (BIS) and Computer Literacy from Grades 4–7, Computer Practice from Grades 8–10, Computer Studies from Grades 11–12, and Integrated Media and Technology Education for Pre-service Teachers in Colleges of Education, which all serve as a foundation for ICT skills training (Tjijombo, 2022). The Namibian basic education curriculum requires that all learners gain ICT skills through all subjects, so mathematics teachers must incorporate it into their teaching processes too.

ICT plays an important role in education. It can transform education, improve teacher design work, the roles of teachers and learners in the teaching and learning process of mathematics (Zakaria & Khalid, 2016). In addition, it can increase students' interest in

mathematics, which brings about improvement in their performance, encourage lifelong learning, enable positive interactions, and support constructivist learning (Amuko, 2015). Further, ICT integration helps visualize mathematical concepts in multiple ways, and combining diverse environments opens up new possibilities (Hegedus et al., 2016). Furthermore, technology improves math instruction and helps students grasp basic concepts and logic (Korda et al., 2022). Moreover, ICT integration in mathematics can also improve knowledge, skills, abilities, achievement, self-learning capacity, communication skills, problem-solving skills, motivation to learn, mathematical understanding, fun learning, and mathematical problem solving. Similarly, ICT integration also helps mathematics teachers improve lesson planning, teaching methods, subjective and pedagogical knowledge, and other abilities. ICT integration also engages students, boosts mathematics confidence, and fosters many subjective concepts. ICT integration should also improve mathematics learning (National Institute for Educational Development [NIED], 2018). Technology-taught students are motivated to learn on their own as ICT fosters an environment where students collaborate with one another to build knowledge (Hammou & Elfatih, 2019). This increases intrinsic motivation and creates a new kind of communication where students become part of a community (Hammou & Elfatih, 2019). Therefore, ICT integration in teaching and learning of mathematics is crucial.

After independence in 1990, the Government of the Republic of Namibia (GRN) wanted to take advantage of new ICT opportunities, so it developed policies and methods for ICT integration into education (Tjijombo, 2022). The strategic plan, national and education ICT policies, and the Education and Training Sector Improvement Programme (ETSIP) are the policies. These policies explain ways to

meet the development goals set by the Republic of Namibia in the National Development Plans 2 and 3 (NDP 2 and 3) and Vision 2030.

Namibia's education ICT policy aims to:

1. ICT-literate citizens
2. Prepare people for ICT-driven economies and communities.
3. Use ICT to help students and instructors across the curriculum.
4. Improve educational administration and management in the classroom, school library, school, and sector.
5. Provide quality education to all students.
6. Establish criteria and targets to classify ICT at different educational development levels (Ministry of Education, 2005:14).

A knowledge-based economy demands widespread availability and accessibility of a broad range of communication and technology infrastructure services, which require skills development to support and enable full use of ICTs (Republic of Namibia, 2017). Thus, the Namibian government has highlighted the things it has to prevent and undertake to ensure that the country advances in ICT by 2030. The following table summarizes a revised Namibia's 2030 ICT development goals.

Table 1.1. Where Namibia wants to be by the year 2030 (Republic of Namibia, 2017)

Information and Communication Technology		
what to avoid	What to be done	Where Namibia wants to be
<ul style="list-style-type: none"> • Lack of ICT implementation • Inadequate investment into improving basic education in Mathematics and IT • No investment or policy to increase internet access across Namibia • No investment into improving internet speed in Namibia 	<ul style="list-style-type: none"> • Develop and implement a comprehensive ICT policy • Integrate ICT education and training in school curricular • Improve access to ICT facilities for all members of the Namibian society 	<ul style="list-style-type: none"> • Comprehensive national ICT policy fully implemented • IT training from pre-primary through secondary education • Internet access available to and used by most Namibians • Internet-based training facilities reach all Namibians • Wireless network installed across the country • ICT infrastructures and services advanced

Namibian schools have implemented several ICT integrations programs. Tech/Na, NETSS, X-net secretariat, and the ICT Literacy Foundation Curriculum for Literacy and ICT for Education (ICTED) are among these efforts (Kacelo et al., 2019). Tech/Na was part of ETSIP, a comprehensive ICT integration effort for the education sector (Kacelo et al., 2019). The Tech/Na! program provided that all education institutions could efficiently use ICTs to accomplish their educational goals and equip, educate, and empower instructors in ICT literacy and integration. In 2007, Tech/Na created the International Computer Driving License (ICDL) course for teachers to improve their computer and ICT skills (Kacelo et al., 2019). The ICTED gave instructors ICDL training guides, and the X-net secretariat gave internet to the Namibian schools (Kacelo et al., 2019). The Tech/Na! Program purchased ICT equipment for schools, libraries, and TRCs around the nation. The Global e-School Initiative (GeSCI), School-net Namibia, the Namibia Education Training Academy (NETA), and Computer Education Community Services (CECS) donate ICT tools and teacher training to remote schools (Ngololo et al., 2012).

This study employed the Substitution Augmentation Modification Redefinition (SAMR) methodology to examine secondary school mathematics teachers' ICT integration in the Ohangwena Region. The SAMR model is a four-step ladder for selecting, using, and assessing technology in basic education by describing the levels of technology integration (Puentedura, 2014). The model offers a method of seeing how computer technology might impact the teaching and learning by outlining a progression that educators follow towards redefining teaching and learning with

technology (Naira et al., 2021). Thus, the study assessed mathematics teachers' ICT integration using the SAMR paradigm.

1.3 Statement of the problem

The speedy spread and use of ICT in all parts of life makes ICT skills one of the core skills needed for a knowledge-based society in the Namibian basic education system (MoEAC, 2016). In addition, ICT provides a great deal of benefit in the provision of equitable, quality education, thus providing an opportunity to improve the lives of the people (Ministry of Education, 2005).

The Namibian government has signed a memorandum of understanding with the Millennium Challenge Corporation of America (MCC) through a Millennium Challenge Account (MCA) to develop many sectors in Namibia, including education (MCA-Namibia, 2014). The MCA's education goal was to improve education by giving new classroom furniture and equipment and access to knowledge and learning materials (MCA-Namibia, 2014). The Millennium Challenge Account (MCA) improved infrastructure at 47 Namibian schools. Ten schools are in Ohangwena (MCA-Namibia, 2014), and three are from Ongha circuit which are the sample of this study. The MCA also trained teachers to use the beneficiary schools' ICT facilities (MCA-Namibia, 2014) .

Despite the provision of ICT-related infrastructure, furniture, and equipment such as computers, laboratories, and wireless internet to MCA schools as well as ICT training given to teachers (MCA-Namibia, 2014), the level of ICT integration at MCA schools is yet to be established, especially in mathematics. Studies conducted in mathematics and ICT focused on the use of ICT tools to improve performance (Kanandjebo, 2016;

Ugulu, 2019). In addition, other studies conducted in other subjects linked to mathematics and to areas of ICT did not focus on teachers' ICT integration levels. Therefore, this study assessed the secondary mathematics teachers' level of ICT integration at MCA beneficial schools in Ongcha Circuit of Ohangwena Region using the SAMR model. This study was guided by the following research questions:

1. What is the teachers' level of ICT integration in mathematics in MCA schools in Ohangwena Region?
2. What challenges impede the integration of ICT in the teaching of mathematics at MCA beneficial schools in the Ohangwena region?
3. How can the problems with integrating ICT in MCA schools in the Ohangwena Region be solved?

1.4 Significance of the study

The findings of this study may be viewed as a source of literature in the area of ICT and provide valuable insight into the teaching of mathematics using ICT. The study provides information about the challenges that mathematics teachers encounter while integrating ICT and possible strategies to enhance the integration of ICT in the teaching and learning of mathematics.

1.5 Limitations of the study

Limitations of any particular study concern potential weaknesses that are usually out of the researcher's control and are closely associated with the chosen research design, statistical model constraints, funding constraints, time constraints, lack of previous studies in the research area, or other factors (Theofanidis & Fountouki, 2019). The following were the limitations of this study:

The research took place during the peak of the COVID-19 pandemic and took longer than necessary to complete the data collection process since it was tricky to carry out the face-to-face interviews in the selected secondary schools. Some protocols had to be observed to ensure that no transmission of the virus would occur. Some teachers happen not to be at schools during their interview schedules because of COVID-19 protocols. Therefore, the researcher had to reschedule interview sessions for them when they were available. Time was another limiting factor because the researcher had to strike a balance between work, research, and social responsibilities at home. The researcher had to, therefore, wisely budget her time. There was a limited literature on the use of the SAMR model in mathematics at the secondary school level; therefore, the researcher also considered reviewing studies in ICT integration even without the SAMR model. This study involved three schools in the Ohangwena education region. Therefore, the results may not be generalized across Namibia.

1.6 Delimitation of the study

According to Theofanidis & Fountouki (2019), the term "delimitation" refers to the boundaries of the study. The dynamics of delimitations include the variables of interest, the population you wish to study, the objectives you may set, and the theoretical perspectives that you adopted. It is critical to note that the delimitations section of the study should explain the criteria for participants to be included, the geographical region to be covered, and the institutions to involve in the study (Theofanidis & Fountouki, 2019). The study was restricted to the secondary school mathematics teachers from MCA schools in Ongha Circuit of Ohangwena Region.

1.7 Definition of terms

The key terms used in this study should be understood as follows:

Challenges refer to conditions that make it difficult to make progress or to achieve an objective (Akhtar & Roshan, 2022). In this study, challenges are conditions that prevent secondary mathematics teachers at the MCA schools from integrating ICT into their lessons.

ICTs refer to all the technologies used for the handling and communication of information and their specific use in education (Ministry of Education, 2005). In the context of this study, ICTs are structures like computers, laptops, printers, scanners, cell phones, and software programs, as well as data projectors, which are used in schools. Therefore, the terms "ICTs" and "ICT tools" are used interchangeably in this study.

ICT integration refers to the use of technological equipment (mainly computers) in classroom teaching and learning by students and teachers aimed at facilitating and enhancing understanding of the intended knowledge (Abel et al., 2022). In the context of this study, "ICT integration" refers to the teaching with the use of ICT tools. ICT integration and use are used interchangeably in this study.

Levels of ICT integration This refers to teacher knowledge in teaching and learning with the use of ICTs (Amuko, 2015, p. 12). In this study, the levels of ICT integration refer to the levels of the SMAR model at which the MCA mathematics teachers are integrating ICT into their mathematics lesson presentations.

MCA schools These are schools that benefited from the Millennium Challenge Account. **The SAMR model** refers to an acronym standing for substitution, augmentation, modification, and redefinition. The model is used to rank the integration of ICT (Puentedura, 2014).

Poor ICT tools refer to the ICT tools that are not efficiently functioning.

1.8 Outline of the thesis

The dissertation is organized into five chapters, as follows:

Chapter One: This part introduced the reader to the background of the study; its aim and objectives were listed, along with their significance, delimitation, and limitations. The definition of key terms in the study also forms part of this chapter, followed by the organization of the study.

Chapter Two: The second chapter presented the theoretical framework of the study and a comprehensive review of the literature relevant to the study. This chapter presented the SAMR model and the constructivist theory of learning as the theoretical framework of the study. The reviewed literature in this chapter mainly pivots on teachers' levels of ICT integration in classrooms, the challenges to ICT integration, and the mitigation strategies to curb the challenges being faced by teachers in the integration of ICT in teaching. Finally, this chapter ended by presenting the strategies to mitigate the challenges being faced by teachers and students during the integration of ICT in teaching and learning in schools.

Chapter Three: This chapter discusses the study methodology used in the study in the finest detail, including the approach and the design employed; sampling and

instrumentation are not left out. Data collection strategies and analysis, with details of the ethical guidelines that were adhered to in conducting the study.

Chapter Four: This part presents the detailed analysis and discusses the data collected in the study in view of the research problem and sub-questions derived from the research problem.

Chapter Five: This chapter summarizes the findings and draws conclusions to answer the research questions from the analysis of the data collected. It makes recommendations on how to mitigate challenges that hinder secondary school teachers from integrating technology into their teaching. The chapter also tells the different groups involved what they should do and leaves a big hole for more research, which was found during the research process.

1.9 Chapter Summary

This chapter outlines the orientation of the study "Assessing mathematics teachers' level of ICT integration using the SAMR model: A case study of MCA schools in Ohangwena Region," the problem statement, the significance of the study, and the research questions. Additionally, the chapter presented the limitations of the study, including the delimitations and definitions of the terms used in the study. The next chapter discusses the theoretical framework in which the SAMR model and the social constructivist theory of learning are deliberated. The chapter also reviewed literature related to ICT integration in the mathematics classroom and challenges encountered by teachers while integrating ICT in their lessons. The next chapter will present a comprehensive review of the literature and the study's theoretical lens.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter discusses the theoretical framework: the SAMR model and the social constructivism theory of learning. The chapter then presents a review of the literature on teachers' levels of ICT integration in classrooms, the challenges to ICT integration, and the mitigation strategies to curb the challenges being faced by teachers in the integration of ICT in teaching.

2.2 Theoretical framework

The SAMR model and social constructivist theory will inform the study. The SAMR model is a framework developed by Puentedura that categorizes four different levels of classroom technology integration (Puentedura, 2014). The study is also using the social constructivist theory of learning by Lev Vygotsky. The social constructivist theories of learning focus on knowledge and explore how people learn (Hammou & Elfatih, 2019).

2.2.1 SAMR Model

According to Puentedura (2014), the SAMR model is intended to be a tool through which one may describe and categorize basic education teachers' use of classroom technology. Therefore, teachers can also use the SAMR model to specifically name their intended level of technology and use and select apps that either redesign tasks or create new, previously unimagined learning tasks (Isaacs, 2017). The SAMR model offers a technique for seeing how computer technology might affect teaching and learning (Puentedura, 2014). Going from the bottom of the SAMR tier is the Substitution level, which is the lowest level of technology integration where

technology directly substitutes for a more traditional one. For instance, on this level, a teacher uses an overhead projector to show a video on how a problem is solved instead of using the chalkboard. The augmentation level is the next, where technology directly substitutes for a traditional one but with significant enhancements for the student. For example, after watching a video, the teacher then allows learners to practice solving the problem using calculators or a spreadsheet. Following the augmentation level up the tier is the modification level, whereby you move from enhancement to transformation on a mode. On the modification level, transformation has begun. For instance, the teacher facilitates more by helping learners use PowerPoint to present their methods of solving mathematics problems. Then lastly, the redefinition level, which represents the pinnacle of how technology can transform students' experiences (Hamilton et al., 2016), On this level, the employment of new tasks is focused. For instance, a teacher can help learners come up with videos of their own that show how a mathematics problem can be solved, and these videos can then be shared on social media sites such as YouTube. The following figure indicates the four tiers of the SAMR model.

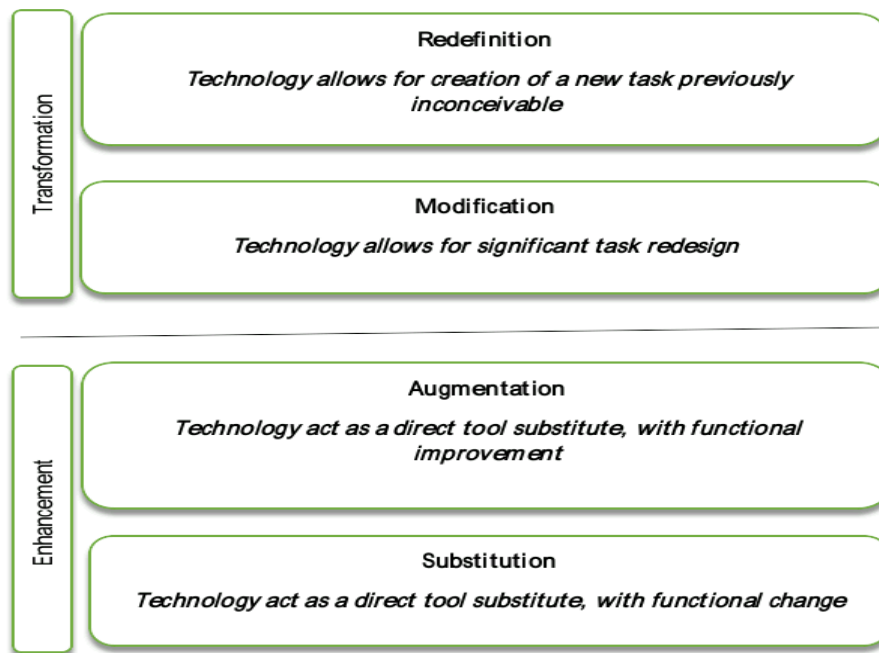


Figure 2.1. The SAMR Model Adapted from (Puentedura, 2014)

Puentedura (2014) argued that technology education existed in an environment where the teachers had curricular goals that the technology would help meet as well as activities that could help meet the goals. The point is not to simply teach with technology but to use it to present information or learning activities (Isaacs, 2017).

Using technology that is at the high level of the SAMR model enhances students' learning (Isaacs, 2017). Further, Isaacs (2017) stated that technology should not just be used because it is available; teachers should strive to select technology activities at the high levels of SAMR to add value to instruction. Therefore, for every level of the SAMR model, a teacher must reflect on and recognize the value that technology has added to the learner's learning process (Gorman, 2016). For instance, the teacher reflects on whether substitution assisted in learner engagement. In addition, the teacher should recognize that technology has added to the learning experience at the augmentation level. Further, on the modification level, the teacher must reflect on whether the technology allowed for some project redesign that enhanced the project

while still accomplishing the learning objective. Finally, on the redefinition level, the teacher must reflect on whether the redesign still accomplished the original standards while at the same time allowing for engaged learner-centered learning (Gorman, 2016). This then means, on the SAMR model, the teacher is not only ranked on what he or she can do but also on what learners can do with the teacher's help.

The SAMR model shows a progression that adopters of education technology often follow as they progress via teaching and learning with technology (Budiman et al., 2018). Further, the model guides teachers to use technology in the classrooms as well as to rank the basic education teachers' use of classroom technology (Isaacs, 2017). Moreover, understanding the SAMR model allows educators to reflect on their own progress while investigating ways to use educational technology in a useful and productive manner (Gorman, 2016). Therefore, the SAMR model helped the present researcher to categorize levels of ICT integration among secondary mathematics teachers at MCA schools in Ongha Circuit of Ohangwena Educational Region.

2.2.2 The social constructivist theory of learning

These learning theories suggest that people construct meaning through their interactions and experiences in social environments (Hammou & Elfatih, 2019). Under social constructivism, reality is constructed through human activity (Jha, 2017). This means knowledge is constructed in the communities we live in through our culture, making learning a social process. The ICT-integrated tools provide opportunities for a social constructivist approach to collaborative learning and stimulate social and communication skills by generating a classroom atmosphere that emphasizes collaboration and the exchange of ideas (Chand, 2018). Apart from

collegial learning, the use of ICTs in teaching and learning processes brings about collective learning, alternative assessment, and knowledge building (Jha, 2017).

The philosophical view of social constructivism holds that reality is, in the most direct and concrete sense, the mental construction of those who believe that they have discovered and investigated (Mhlongo et al., 2017). Three fundamental elements that underpin social constructivism were identified as follows: the first is cognitive activity, which is a developmental process of making meaning. Mhlongo et al. (2017) stated that, apart from being used as a tool for collaboration, technology can also be used to facilitate the scaffolding technique that is an important part of the fundamental elements of socio-constructivism. In a classroom setting, the following table shows how technology fits into the three main parts of social constructivism.

Table 2.1 The role of technology across the three fundamental elements of social constructivism in a classroom setup (Mhlongo et al., 2017)

Element	Role of Technology
Cognitive activity	<ul style="list-style-type: none"> <li data-bbox="756 1352 1402 1547">✓ It can be used to get up to date context related information that can be used as part of learners' knowledge construction process. <li data-bbox="756 1599 1402 1711">✓ It encourages and facilitates learners' creativity. <li data-bbox="756 1762 1402 1957">✓ Cognitive tools include those that are used for storing, calculating, presenting data, the use of spreadsheet, and communication software,

	such as teleconferencing programs (Mhlongo et al., 2017).
Cultural knowledge, tools and signs	<ul style="list-style-type: none"> ✓ It can be enculturated into the classroom and becomes a classroom cultural norm ✓ It can be leveraged as a tool to find context-fitting material to be used during classroom discourse
Assisted learning	<ul style="list-style-type: none"> ✓ It can be leveraged as a tool to facilitate scaffolding to assist learners through the learning process within the ZPD. ✓ It can be used as a descriptive tool to assist the teacher to assist learners where concepts are complex to demonstrate. ✓ Example of assisted learning tools are: Computer programs such as electronic math worksheet, electronic calculators, math notation tools graphic tools, drawing tools, equation solving tools and graphic organiser can be used (Akpan & Beard, 2014).

Technology has the power to facilitate social teamwork when used correctly (Mhlongo et al., 2017). They further stated that social constructivism advocates for collaboration, and its approach would be an effective method in which to use technology in the

classroom environment. The successful use of technology in the classroom is premised on both teachers' and learners' attitudes towards the usefulness of education technology (Mhlongo et al., 2017). Therefore, in their opinion, teachers' perception of ICT in their professional environment is crucial, and as a key factor in the socio-constructivist approach, teachers must be digitally fluent and pedagogically grounded in the use of technology to enable an interactive teaching environment (Mhlongo et al., 2017).

ICT comprises all innovative tools of digital technology, which have helped in all field different cultures communicate and the information in an addition manner. In addition, Jo Shan (2020) stated that the use of ICT has enabled people from intercultural to come together to share ideas and experiences, and that through teaching and learning processes, awareness of the use of computers and other devices is created, which leads to knowledge acquisition. Further, Genlott & Grönlund (2016) indicated that the use of ICT has promoted the teaching and learning process and made it superior, and it also creates an opportunity for teachers to change their teaching styles to ensure effective learning as it helps teachers to identify systematic problems and to discover systematic solutions. Social constructivism complements education technology as it advocates for learners to be taken away from standardized curriculum and that their learning skills are developed through experiential learning. Social constructivism also focuses on bringing out the prior knowledge of learners, and the effective use of ICTs helps teachers know better about the learners' prior knowledge and facilitate knowledge acquisition (Genlott & Grönlund, 2016). For instance, the use of computers, laptops, overhead projectors, and the internet helps teachers assist learners to learn outside the classroom and helps the teacher easily understand the learners' prior knowledge.

Assisted learning can be used as a tool to facilitate scaffolding to assist learners through the learning process within the ZPD. The ZPD, as cited by Polly and Bykerool to facilitate scaffolding to assist learners through the learning process within the ZPD. The ZPD, as cited by Polly and Byker (2020), has been identified as a distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under the guidance of a more knowledgeable person. ZPD provides a way of thinking about how individuals develop skills and knowledge through scaffolding, modeling, coaching, and situated learning supports to guide the transfer of knowledge and skills (Polly & Byker, 2020). The following figure explains the ZPD.

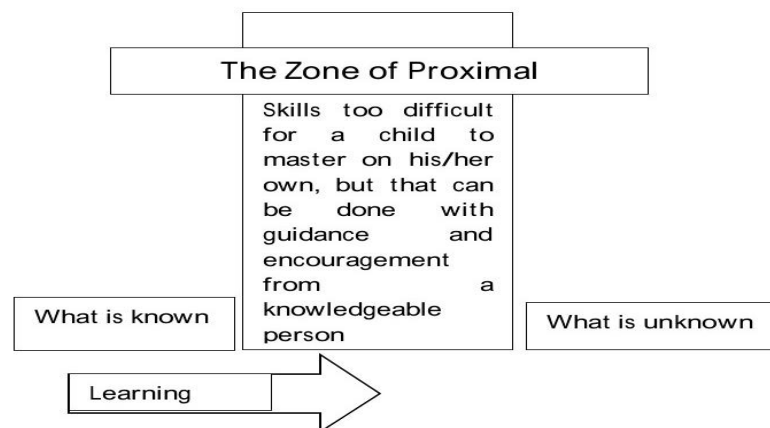


Figure 2.2 The Zone of Proximal Development

ZPD focuses more on the scaffolding and guidance through the various stages of performance. Vygotsky believed that a person has not only a set of abilities but also a set of potential abilities that can be realized if given proper guidance from others (Polly & Byker, 2020). This is important because it helps teachers identify the gap between what they can do on their own and when they are assisted. Since teachers at MCA schools were given training on how to use the ICT facilities provided in their schools, the study was then designed to determine the set of abilities of secondary mathematics

teachers after their training by assessing their level of ICT integration in teaching using the SAMR model.

2.2.3 Justification of the use of the constructivism theory of learning

MoEAC expects teachers to integrate ICT into their teaching (MoEAC, 2016). The relevance of constructivism theory is paramount to the contribution of ICT to the teaching and learning environment. It is suggested that learning with ICT is closely linked to a constructivist theory of learning (Polly & Byker, 2020).

The constructivism school of thought is of relevance to this study as it emphasizes group study, sets concept-learning goals, and also develops the best methods of learning and studying and learns from others through collaborative learning. The theories assisted the researcher in understanding the importance of ICT integration and how it could be integrated into teaching and learning processes in MCA schools, leading to a much clearer picture of the teachers' level of ICT integration in their teaching of mathematics. The theories also helped in establishing whether teachers who integrated ICT into their teaching and learning processes were in line with constructivist principles.

2.3 The teachers' level of ICT integration

The rapid spread and use of ICT in all areas of life make ICT skills part of the core skills needed for a knowledge-based society (MoEAC, 2016). The attainment of mathematics teaching and learning as well as performance and achievements in mathematics could be achieved by a high level of ICT integration in teaching and learning processes (Maharjan et al., 2022). A study done on the evaluation of the implementation of the national ICT policy for education in Namibian rural science

classrooms revealed that ICT implementation was at a low level on specific subjects (Ngololo et al., 2012). Another study on the framework for integration of ICTs in teaching and learning processes in secondary schools in Machakos sub-county, Mutuku (2014,) also revealed low ICT integration due to lack of fund, poor training on ICT usage among teachers, sands as lack of incentives. A study on the teachers' perceptions of the use of ICT in teaching and learning indicated a moderate use of ICT in mathematics (Havu-Nuutinen et al., 2018). In addition, Amuko (2015,) on the study about the integration of information and communication technology in mathematics at the secondary school level, and Naufal et al,(2015,) on the study about teachers' levels of ICT integration and its perceived impact on teaching and learning, both revealed ad low level of ICT integration

The study done about teacher-learner perceptions of mobile learning technology. Odiakaosa et al. (2017) found that most educators and learners in Namibia possess mobile ICT tools that can be used for mobile learning. However, there is still low level of ICT use in schools. Amunyela (2020) found out that teachers are at the low level of ICT integration as they poorly use websites in several ways Agyei et al. (2022) found out that teachers had all the ICTs at their disposal but were still at a low level of ICT integration. Some teachers happen to possess high technology knowledge and self-efficacy, but they had relatively low preparedness and, thus, a low level of ICT integration (Agyei et al., 2022).

Other studies revealed that teachers integrate ICT by choosing the technology that they feel is in line with their instructional goals (Jatileni & Jatileni, 2018; Mcculloch et al., 2018). This is because they want to use the ICT tools that they are most comfortable with. In the study on teachers' perceptions of the use of ICT in teaching and learning,

Jatileni & Jatileni (2018) also revealed that math teachers choose ICT in teaching and learning based on the administrative and pedagogical purposes as well as the lesson objectives, learners' learning needs, and the availability of the ICT tools at school. This act, according to Agyei et al. (2022), symbolizes the low level of ICT integration.

The study done on Google through quizzes and SAMR model integration revealed that not all teachers were able to reach the transformation levels of the SAMR model, and only a few of them managed to reach all levels of the SAMR model. This finding agrees with the finding in the study by Wijaya et al. (2021), who highlighted that the ability of teachers to integrate ICT in statistics lessons during the Corona virus pandemic was at every level of the SAMR model, with a few reaching the highest level of the SAMR model. Furthermore, Kihzoza et al. (2016) stated in their study that the teachers exhibited good knowledge of the SAMR constructs that were assessed but had poor ICT skills and insufficient support for the use of ICT tools. Moreover, Budiman et al. (2018) conducted a study on EFL teachers' beliefs and practices on integrating ICT in the classroom and revealed that even though teachers have been integrating ICT, they were still at the substitution and augmentation levels of ICT integration, and that they hardly achieved the modification and redefinition levels of the SAMR model. This finding is supported by Tunjera and Chigona (2019), who revealed in their studied that teacher educators are appropriating technologies inharmonic with traditional teaching methods at the enhancement levels. Another study also revealed that the level of ICT integration among educators was ranked at enhancement levels of the SAMR mode, due to lack of knowledge on how to use the ICT available at their disposal (Jude et al., 2014)..

Saraswathy (2022) revealed the level of mathematics utilization and the level of competency in the utilization of ICT tools for both teachers and learners to be high. This concurs with the study by Nair and Chuan (2021), who in their study about integrating technology that uses the modified SAMR model as a pedagogical framework in evaluating learning identified that there was a presence of content, pedagogy, and technology in the augmentation, modification, and redefinition levels of the SAMR model. They also revealed that the participants possess more knowledge on the high level of the SAMR model. Nair and Chuan (2021), who also highlighted that the model is usable to enhance and improve students' performance, Teachers utilized technology in the teaching based on TPACK with a high level of technology integration in the SAMR model (Adulyasas, 2021).

Looking at the reviewed studies in this section, it seems that the ICT integration is at a low or moderate level. A high level of ICT integration seems to be reached at a very slow pace. On the SAMR model levels, it also seems that the modifications and redefinitions are not or are hardly reached.

2.4 Challenges to ICT Integration

Different reviewed studies outlined some barriers to ICT integration, such as lack of access to ICT infrastructures and inadequate or poor ICT facilities, lack of technical skills and inadequate technical support, lack of confidence among teachers during ICT integration, and a lack of relevant training and training opportunities. In addition, lack of time to integrate ICT, as well as higher prices for ICT tools and maintenance costs, were also outlined as challenges to ICT integration.

2.4.1 Lack of access to ICT infrastructure and poor or inadequate ICT facilities

The lack of access to ICT tools and infrastructure gives teachers reasons for not integrating ICT in the teaching and learning processes (Angula et al., 2019; Ugulu, 2019). In addition, Gupta & Gupta (2011) cite a lack of access to resources, including home access, as another complex challenge that prevents teachers from effectively integrating new technology during teaching and learning in the classroom. They continued to say that in some instances, teachers had to book computers in advance for use in the classroom but would sometimes forget to do so due to a long sharing chain caused by a shortage of computers in the school. Further, the inadequate or poor ICT facilities make it hard for teachers to work with ease, as it creates worries in teachers about how well and fast, they can use available ICT facilities to make sure they finish on time for the next teacher to use (Amuko, 2015; Nendongo, 2018). This finding was supported by Amuko (2015), who indicated that the non-functionality of some ICT infrastructures leads to inadequate facilities and thus discourages teachers from teaching with the use of ICT in mathematics.

Recent studies claim that not all students or teachers use computers at home, and those that do are either frequent users, have sufficient data, or lack internet access. Ojo and Adu (2018) state that there is a "digital divide" or reduced computer literacy in students from indigenous lower socio-economic or rural backgrounds, and this creates challenges for teachers if they have to set different tasks for different students or if they avoid setting homework with a digital component. He also added that having no computers at home affects the students' performance and the digital world immensely. He further claims that the teacher will no longer be able to link up with his students

online to give them learning material, and neither can the students be able to submit assignments and other assessment material to their teacher via the same trajectory.

2.4.2. Lack of technical skills and inadequate technical support

Reviewed studies also revealed that teachers face challenges in developing their own technological skills, knowledge, and self-training in the use of ICT in their teaching (Amuko, 2015). On the same point, some researchers also revealed that teachers demonstrated the use of ICT in their presentations but did not develop their own teaching materials (Simon & Ngololo, 2018). In addition, some studies also found challenges in teachers, such as the lack of technical skills to develop digital mathematical contents (Das, 2019) and to prepare teaching materials based on technology (Martin & Nobis, 2021), as well as a lack of technological skills and knowledge about ways to integrate ICT in lessons (Agyei et al., 2022; Nendongo, 2018).

Lack of or inadequate technological support while using ICT tools provides teachers with reasons not to integrate ICT in their lessons (Abhilasha et al., 2019; Amunyela, 2020; Apeanti, 2016; Das, 2019). Recent research found out that some schools that benefited from donated computers have not been adequately equipped with the same for the support, maintenance and repair, hence it is very common to see a school's computer laboratory full of broken-down computers, some repairable and others not (Mcculloch et al., 2018). It therefore means the whole system will not be able to be driven forward owing to computers having technical faults that perhaps would have accumulated over time due to a lack of the technical skills to repair them (Holloway, 2015). This idea was supported by Ader (2016), who concluded that the absence of technical skills on the part of the teacher means that learning cannot continue to take

place in the classroom. He also found out in the same study that as computers break down and are piled up somewhere, it means that each time they are being reduced in number and will not be sufficient for use by the different classes at school.

This view was supported by Moses et al. (2022), who in their studies found that schools have computers that are housed in the computer laboratories, where they remain idle and unusable owing to a lack of technical expertise on the part of the teaching staff. They further recommend the need for a technical expert who, from time to time, attends to technical faults when the need arises. Finally, Simon & Ngololo (2018) argued that whatever kind of technical support and access the teaching staff has and whether they have many or few years of teaching experience in the profession, technical problems generate barriers to the smooth lesson delivery by teachers.

2.4.3 Teachers' attitudes and confidence towards ICT integration

Teachers' attitudes and beliefs play a very significant role in bringing about didactic change related to the use of ICT for teaching and learning processes. The results of the study by Grove et al. (2013) indicated that teachers believed they were not being adequately rewarded, supported, or guided using technology in their teaching practice. It is the attitude that brings about confidence in doing what they do best. (Apeanti, 2016) In addition, some researchers outlined a lack of confidence among teachers during ICT integration as one of the challenges to ICT integration (Apeanti, 2016; Simon & Ngololo, 2018). Furthermore, Apeanti (2016) claims that negative attitudes and a lack of confidence make teachers believe they are unable to meet challenges, and sometimes they feel they are not good enough to do something on their own. Therefore, successful ICT integration requires a positive attitude from the teaching staff and all educational stakeholders in order to enhance the learning environment

(Simon & Ngololo, 2018). This view was supported by Nchindo (2019) who said good attitudes play a very significant role in bringing about didactic change related to the use of ICT for teaching and learning processes. Furthermore, the results of the study by Grove et al. (2013) indicated that teachers believed they were not being adequately rewarded, supported, or guided by the use of technology in their teaching practice. It is the attitude that brings about confidence in doing what they do best. (Apeanti, 2016) In addition, some researchers outlined a lack of confidence among teachers during ICT integration as one of the challenges to ICT integration (Apeanti, 2016; Simon & Ngololo, 2018). Moreover, Apeanti (2016) claims that negative attitudes and a lack of confidence make teachers believe they are unable to meet challenges, and sometimes they feel they are not good enough to do something on their own. Therefore, successful ICT integration requires a positive attitude from the teaching staff and all educational stakeholders in order to enhance the learning environment (Simon & Ngololo, 2018). This view was supported by Nchindo (2019), who argued that while bringing technology into the classroom, there is an urgent need to change the teacher's attitude towards the use of technologies. Negative attitudes towards the use of ICT bring about a lack of interest in teaching with the use of ICT tools (Angula et al., 2019; Ngololo et al., 2012; Ugulu, 2019). Ader (2016), Waiganjo & Paxula (2020) summarized this idea that a positive approach by the teacher yields the desired results and the achievement of the institutions' goals and objectives.

2.4.4 Lack of relevant training and training opportunities

Another challenge is the lack of effective training opportunities for teachers to acquire knowledge on ICT integration (Abhilasha et al., 2019; Agyei et al., 2022; Apeanti, 2016; Das, 2019). Continuous professional development plays a major role in boosting

teachers' confidence, and it motivates teachers to be active as they gain new knowledge. Training opportunities based on ICT help teachers gain pedagogical knowledge, which they can use to integrate ICT in their lessons (Das, 2019). He further added that teachers can also be motivated through these training opportunities as they meet experts in the field and other teachers who they can interact with in case they need help during their lesson preparations or presentations. In addition, Ngeama (2018) revealed that teachers have prior professional training on ICT; however, it is recommended that they receive advanced ICT training on the use of ICT in classrooms. It is due to a lack of digital technology skills, teachers avoid using digital technology in their classes (Nchindo, 2019). Further, Tshabalala & Ncube (2014) say that lack of computer education and skills is a major concern in today's world as all we do requires the integration of ICT. Ader (2016) further supported them when he observed that there are many students who still cannot operate basic computers with MS Word and PowerPoint and that, whenever some technical issues emerge, they find it difficult to solve the problem in such a scenario. This also prevents teachers from integrating ICT, as they first need to train learners on the use of ICT tools, which is why an Information and Communication subject needs to be a promotional subject in Namibia (Tjijombo, 2022). This view concurs with the views of Perienen (2020), who in his study recommended the need for mathematics teachers to be adequately trained in the pedagogical integration of ICT in teaching and learning processes.

2.4.5 Lack of time to integrate ICT

Several recent studies indicate that many teachers have competence in using computers in the classroom, but they still make little use of technologies because they lack time (Abhilasha et al., 2019; Apeanti, 2016; Das, 2019). In addition, Abhilasha et al. (2019) stated that the use of ICT tools wastes time, as teachers have to plan technology

lessons, explore the different internet sites, or look at various aspects of educational software. Furthermore, Apeanti (2016) further claimed that lack of time exists in many aspects of teachers' work as it affects their ability to complete tasks, as they need to avail time to locate internet advice, prepare lessons, explore and practice using the technology, and also to deal with technical problems. Moreover, teachers have overcrowded course outlines that they are expected to cover in a short time, and therefore, insufficient time due to the overburdened timetable and other school responsibilities hamper teachers' ability to take out time for searching on the internet and using computers as teaching aids (Simon & Ngololo, 2018).

2.4.6 Language Challenge

The medium of instruction plays a role in ICT integration, as it is the only language for communicating (Thi, 2020). In addition, Otieno (2018) claims that the curriculum and medium of instruction are the major impediments to the effective integration of ICT in schools. Further, software and online contents are in English, and this alone is a serious barrier, especially where English is not a first language in schools, as it limits access to those who are not fluent in it. Finally, in support are Ra & Anisha (2018), who in their studies found out that language of instruction can lead to poor integration of ICT.

2.4.7 Lack of teachers specializing in ICT

According to Okumura (2017), lack of teachers specializing in ICT can prohibit the integration of ICT in all subjects. He also added that specialist teachers are generally expected to have high subject proficiency and teaching skills, and they also possess expertise in terms of the selection materials that they use to enrich their teaching contents. He further stated that specialists focus on teaching their subject. Furthermore,

McLinden et al. (2016) support the views of specialized teachers when they state that these teachers know appropriate approaches and strategies for ICT integration, understand the range of barriers and ways to mitigate them, and are also able to identify, design, and evaluate appropriate materials for ICT integration. Therefore, the absence of ICT specialized teachers leads to the poor or not integration of ICT (McLinden et al. 2016)

2.4.8 Lack of related guidelines and teaching aids for ICT integration

The provision of ICT software and other teaching aids for ICT integration in schools is paramount (Ngeama, 2018). According to Rani and Anisha (2018), lack of support in terms of appropriate software as well as supportive documents to guide the integration of ICT gives reasons to teachers for not integrating ICT. In addition, Thi (2020) is in agreement when she states that a lack of appropriate software forces teachers to use basic applications, which discourages teachers from integrating ICT. Further, Barakabitze et al. (2019) and Martin & Nobis (2021) summarized by stating that related guidelines and teaching aids for ICT integration are lacking in most developing African countries, and this leads to poor ICT integration in all sectors. The study on the barriers to effective integration of information and communication technology in Harare secondary schools showed that there was limited use of ICT pedagogy in the classrooms. Thus, according to Mutuku, (2014), was a result of lack of clear sense of direction on how to use ICT to help learning, inadequate resources. Another study conducted by Quest (2014) in Malaysia found that schools might have a laboratory full of modern computer hardware and, of course, many syllabi in the school, but without the availability of textbooks and other material to support the ICT tools, the teaching and learning process becomes null and void. He gave a list of the teaching materials, including projectors, digital cameras, printers, photocopiers,

tablets, pen drives, an interactive white board, DVDs, and many others. He further stated that the limited availability of resources in the classrooms results in the lack of ICT integration in teaching and learning processes.

2.4.9 A lack of collaborations

Knowledge sharing and collaboration within schools are considered important change factors, as teachers who work together have a high opportunity to discuss concepts, skills, and problems arising from professional development activities (Li et al., 2019). ICT use without collaboration and integration in social learning activities prevents learning (Genlott & Grönlund, 2016). In their study, Yamanmoto & Yamgauchi (2019) argued that teachers' collaborations that stimulate innovation are associated with both teachers' ICT use in teaching and funding allocation for ICT training. Therefore, requested funding provisions were made for teachers to be able to work closely with other teachers in the same areas and those that were far away.

2.5 Mitigation strategies to curb the challenges being faced by teachers in the integration of ICT in teaching

Mitigation strategies are efforts or steps taken or to be taken in order to reduce the severity of a risk. Babbie et al. (2014) claim that challenges come in different forms and that each challenge comes with a different mitigation strategy. He further added that education leaders should be provided with professional development opportunities so that they can engage teachers and collectively demonstrate a shared commitment to digital technology in educational circles. In their study about the profile of information and communication technology skills in prospective teachers Maryuningsih et al. (2020) also found that good ICT skills in prospective teachers provide a great opportunity to apply learning with good ICT skills input for learners. In managing the

process of introducing technology in schools, the training of educators should be adequate to invigorate facilitators in order to function as computer literate facilitators in a society that calls for the knowledge and skills inclined to technology (Gray, 2014). More professional development activities on the educational use of ICT should focus on the long-term involvement of teachers at the grassroots level and convey the benefits of the use of ICT as well as promote teacher collaboration (Li et al., 2019). In addition, the writers emphasized that any educational department's obligation was to ensure that facilitators are professionally in-serviced on the use of digital technology tools and are also prepared to meet the challenges associated with the teaching and learning of digital technology in schools. The school authorities should also ensure that they create environments in schools that are accommodating to the new culture brought about by exposing classroom practitioners to digital technology (Mcculloch et al., 2018). They claim that networking must prevail among educators and co-operative learning must occur whereby educators share their newly acquired knowledge and skills with each other. A further proposal was that the school's management team must ensure that available computers are shared and used equitably and that the school timetable provides for the introduction of technology to learners. In a study about the assessment of computer and ICT skills among secondary school teachers in Ota Ogum state, Oyeronke and Fagbohun (2013) asserted that teachers are the primary agents of educational innovation. Therefore, they should be provided with ICT tools and adequate ICT integration training.

Grove et al. (2013) suggests that a holistic approach to the development of digital technology in education plans and policies has to be taken, and it should include support for digital technology at both the national and individual school level. This implies that education stakeholders must be involved in putting in place measures on

how to integrate digital technology skills in the curriculum or tap teachers to help develop policy plans. On the issue of leadership and organization, schools need to take risks with technology so that teachers will not invest their own tools to drive the aspirations of the institution (Babbie, 2014).

Holloway (2015) stated that before introducing any policy, such as ICT, for implementation in ministries like education, the policy makers should ensure that the material for use during the implementation process is available in order to make the new trajectory navigable. Holloway (2015) highlighted the need for policymakers to ensure that all materials needed for ICT integration are provided. Resources for a policy to be implemented can be in the form of material and human resources. There is also a need for teachers to undergo ICT integration training, either specifically or in-serviced, for their subject area or the new policy to be implemented (Gussa & Gundula, 2019). This view is supported by Nchindo (2019), who in his study recommends that in-service professional development about ICT integration into mathematics teaching be offered.

In another study, Das (2019) highlighted that the availability of malfunctioning computers in schools is a result of having no technical skills to have them fixed, a skill that all institutions sorely require whenever working with digital technology tools. There has to be one or two technical experts at each school from among the local staff or someone who is independent, depending on the financial muscle of the school (Gray, 2014). The technical personnel are needed not only for solving issues with connectivity and technical flaws of the hardware alone but also for maintenance (Nchindo, 2019). He further stated that running the computer laboratory itself requires someone who is highly qualified in order to make the entire system workable and

manageable. Specialist teachers are needed to make sure that ICT is taught, and learners are enriched with ICT knowledge (Okumura, 2017). Ader (2016) suggests that, as an alternative, students should be provided access to support devices that can help them solve technical problems via call, email, or live chat, and one should pay attention to the instructor during the process of solving the issues. Malfunctioning computers can sometimes be a result of a computer virus. Ngololo (2015:78) came up with suggestions on how to reduce the infection of computers by viruses. The following suggestions were put forward:

- Use antivirus protection and a firewall.
- Get antispyware software.
- Always keep antivirus protection and antispyware software up to date.
- Update the operating system on a regular basis.
- Increase the browser security settings.
- Avoid questionable websites.
- Only download from trusted sites.
- Carefully evaluate free software and file-sharing applications before downloading them.
- Do not open messages from unknown senders.
- Immediately delete messages you suspect to be spam.

Ngololo (2012) claims that there is a tendency by some teachers to use time for computers so as to cover up whatever they would have not done during the term. Such teachers need to be made aware of the importance of digital technology in teaching and learning so that once they get enlightened, Quest (2014) claims that digital technology is quite an involved subject that requires a lot of organizational behavior

well in advance. They also suggested that the question of time being a hindering factor could be redressed by drawing up a well-crafted timetable for each class and leaving room for extra lessons whereby students could go during their free time, say, for at least an hour per day.

2.6 Gaps identified in literature

It seems that several studies reviewed took place at schools with poor, inadequate, or no ICT tools. It also seems that the teachers need more support and training on the use of ICT. However, the schools under this study were provided with ICT facilities, and teachers were also trained on how to use these ICT tools (MCA-Namibia, 2014). Therefore, with the facilities and training provided, this study then intended to find out the teachers' level of ICT integration, how they integrate ICT, and the challenges they are facing when integrating ICT, as well as mitigating strategies to curb the challenges faced by teachers in integrating ICT.

2.7 Chapter summary

This chapter discussed the theoretical framework based on the SAMR model and the constructivism theory of learning. It further discussed the teachers' level of ICT integration, ICT integration in classrooms, and barriers to ICT integration, as well as mitigating strategies to curb the challenges faced by teachers in integrating. It should be noted that some of the studies reviewed in this chapter are not those of mathematics. However, they are of most importance to this study as their contribution helped understand the level of ICT integration among teachers, the barriers to ICT integration, and the mitigating strategies to curb the challenges faced by teachers in integrating

other subjects that are taught together with mathematics. The next chapter will discuss the research methodology.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the design and methods that were used in the study to collect and analyze the data. It first discusses the research design and how the research site and teachers who participate in the study were selected. It then presents the instruments and methods used in collecting data from the sample. The chapter also talked about how the researcher analyzed the data and thought about ethical issues.

3.2 Research design

A research design is a plan or strategy that provides a general organization of the procedures that a researcher has to follow, the data that the researcher needs to collect, and the analysis of the data that the researcher does in order to solve the research problem (Tjijombo, 2022). Further Akhta (2017) defined research design as an advance planning of the methods to be adopted for collecting the significant data and the methods to be used in the analysis, keeping in view the objective of the research study, the availability of staff, time, and money. Research designs help researchers to organize their ideas in a logical order, making it possible to look for errors and shortages, thereby creating research that is professional and yielding maximum information for the least amount of money possible (Akhtar, 2017). Research designs ensure that the responses provided to the research questions are valid and discovered as competently as possible (Mello, 2021). This means, when choosing a research design to follow, the researcher outlines a plan that will direct the proceedings of the study from the beginning to the end, through which the study is to be successfully completed.

In light of the background provided on the research design and the primary objective of the study, which was to assess the secondary school mathematics teachers' levels of ICT integration in their teaching, the study utilized a qualitative research design. The qualitative paradigm is the collection, analysis, and interpretation of comprehensive narrative and visual data to gain insights into a particular phenomenon of interest (Ugulu, 2019). In addition, Nassaji (2020) defined qualitative research design as a type of inquiry that is naturalistic and deals with non-numerical data and that seeks to understand and explore rather than explain and manipulate variables. The study employed a case study approach that focused on the case of three MCA schools. A case study is normally used when a researcher wants to focus on a single unit to produce an in-depth description that is rich and holistic (Budiman et al., 2018). This study was conducted in MCA schools in Ongha Circuit of Ohangwena Region. The qualitative design was chosen because it is the interactive process through which the researcher gains information about the secondary school mathematics teacher's level of ICT integration in their teaching. Moreover, the qualitative design allows the researcher to collect primary data about the secondary school mathematics teacher's level of ICT integration in their teaching.

3.3 Population of the study

According to Tjijombo (2022), a research population is a large collection of individuals or objects that are targeted as the focus of a research study. This study targeted the MCA secondary school mathematics teachers in the Ohangwena region only. There are ten (10) MCA schools in the Ohangwena region and seventeen (17) secondary school mathematics teachers at MCA schools. The population considered

for this study was the secondary school mathematics teachers who were working at the MCA schools in the Ohangwena region.

3.4 Samples and sampling procedures

Sampling is the process of drawing a sample from a population (Muzari et al., 2022). They also added that sampling refers to the process used to choose a given number of people or items from a population to represent the population in a study. A purposive sampling was selected in this study in order to obtain the richest possible sources of information, which assisted in answering the research questions. A purposive sampling is a technique in which a researcher specifies the features of the population of interests and finds individuals with those features to participate in a research study (Muzari et al., 2022). Purposive sampling was chosen based on the notion that the participants were selected because of some defining characteristics that made them the holders of the information needed for the study. For this study, the following steps were taken to choose the people who would take part:

Firstly, the researcher decided to conduct the study in the schools that were beneficial to MCA-Namibia in the Ohangwena region. This is because they were most appropriate to provide information relevant for the study as they received ICT tools from MCA-Namibia. Ohangwena is one of the regions with roads that have too much sand. Some teachers find it hard to get to their working places due to sandy roads. The researcher then wanted to do the study in a circuit with the MCA schools that are a short distance from any tarred road in Ohangwena region. Ongha Circuit was then purposefully selected as it has MCA schools with the characteristics needed. There were three MCA schools in the Ongha circuit. Therefore, three of the ten schools in the Ohangwena education region were purposefully selected to take part in the study.

Out of the ten secondary school mathematics teachers that were working at MCA schools in the Ohangwena region, six of them participated in the study. Therefore, the sample consisted of six secondary school mathematics teachers at the selected schools.

3.5 Research instruments

According to Nassaji (2020), research instruments are data collection tools or techniques for physically obtaining data to be analyzed in a research study. The study was qualitative in nature, and therefore, to ensure a depth of understanding of the secondary school mathematics teachers' level of ICT integration has been achieved, observations and interviews were used as data collection instruments. Interviews and observation were used because the study aimed to obtain primary data on the secondary school mathematics teachers' level of ICT integration.

3.5.1. Observation

Observation is a method of data collection that is systematically planned and recorded, subjected to checks and controls on validity and reliability, and where information is sorted by a researcher's direct observation without asking from a respondent (Mazhar et al., 2021). It is a part of the inquiry process, where researchers watch subjects and events in their natural habitat (Sharma, 2022).

During observations, observation sheets guided the researcher. An observation sheet is an analytical form or a coding sheet, filled out by researchers during observations, that carefully specifies beforehand the categories of events under scrutiny (Coleman, 2020). The observation sheet was used to determine the level of the SAMR model at which the MCA secondary mathematics teachers integrate ICT in mathematics. It was

both a data collection instrument and a data analysis tool. the observation sheet was used a tool to observe and as an analytical tool.

3.5.2 Interviews

Interviews are a set of questions designed to collect primary information on non-measurable phenomena and are used to help the researcher understand and explore research subjects, opinions, and experiences (Tjijombo, 2022). The researcher uses standardized open-ended interviews as a guide to collect and analyze data.

The researcher used interview guides to conduct a face-to-face interview with every secondary school mathematics teacher. The interview guide is a plan to explore specific topics and ask specific open-ended questions of the participants (Nassaji, 2020). The questions for interviews were standardized and open-ended in order for the participants to be able to raise other relevant issues related to the study. The interview guide sought information on how teachers integrate ICT in their teaching and the challenges to ICT integration they encounter and ways to resolve these challenges.

3.6 Pilot Study

The pilot study is a feasibility study, which is done on a small scale in order to prepare for a major study so that the quality and efficiency of the research instruments are improved (Kesting et al., 2022). They further added that a pilot study can provide advance notice about where the main research project could fail, where research protocols are not followed, or whether proposed approaches or instruments are unsuitable or too complicated.

The pilot study was conducted at a different MCA secondary school in another circuit in the Ohangwena region. There was only one mathematics teacher at the school who

taught mathematics at the secondary level (grades 8–9). The observation took place in a Grade 8 lesson. The researcher set the time for the interview as part of the pilot study. It took place after the researcher had observed a class.

The pilot study helped to point out flaws in the instruments. In observation, there was a need to indicate the SAMR level observed. A row was also needed to indicate the other tasks that may be observed during the lesson presentation. All were rectified.

3.7 Data Collection Procedures

After permission was obtained from the executive director of the Ministry of Education, Arts, and Culture and the Ohangwena regional education director, as well as from the school principals of the schools under the study and the participants, data collection then started. The observation took place during classes (from 08:00 to 14:00) for 40 minutes on a single lesson and/or 80 minutes on a double lesson. The researcher observed teachers while they were presenting their mathematics lessons in their classrooms. The school's daily schedule was followed during the observation process in order to prevent lesson disruption. For each mathematics teacher at each school, two lessons were observed. The observation memos were written. The researcher also recorded the lessons observed.

Interviews were conducted with all the secondary mathematics teachers at each MCA-beneficial school. Interviews took place after the observation process, at a time that was suggested by the participant. The interviews were on an individual basis at a comfortable school location of the participants' choice. Voice recorders were used to make sure all the information shared by the interviewees was recorded. The fieldwork took two weeks.

3.8 Data Analysis

Qualitative data analysis is based on an interpretive philosophy with the idea of extracting precise meaning from the collected data (Lester et al., 2020). The study also used a thematic approach, a way of analyzing data gathered by means of an interview (Lester et al., 2020). The sample data collected from observations and interviews were subjected to an interpretive approach, where teachers' levels of ICT integration were ranked using the SAMR ranking. Data recorded during observation were analyzed using content analysis. To analyze the data in order to answer the first question of the study, the researcher combined all data of all participants from observations and then determined the SAMR level by identifying the most occupied level. For data collected by interview, the researcher used a checklist to identify the level of integration for every activity that the teacher did. The combined data of observation and that of the interview was combined and then tabulated. The researcher then determines the overall levels of integration from the table by looking at the level that was mostly occupied by teachers. The data recorded during the interview aiming to answer the second and third questions of the study, was transcribed into verbatim. The overall data was categorized under themes based on the research questions of the study. These themes are: teachers' level of ICT integration of Mathematics in MCA schools in Ohangwena Region the teachers'; the challenges impede the integration of ICT in the teaching of mathematics at MCA beneficially schools; and the strategies that can be used to overcome the challenges of ICT integration in the MCA schools.

3.9. Data verification

In qualitative research, "verification" refers to the mechanisms used during the process of research to incrementally lead to ensuring reliability and validity, and, thus, the

consistency of a study (Daher et al., 2022). In this study the data collection instruments were piloted at MCA school in another circuit; various research experts including the supervisor of this thesis work were consulted in order to help in the validation of the instruments. In addition, validity and reliability in qualitative research refer to research that is trustworthy; this means the research should be credible, dependable, transferable, conformable, and authentic (Daher et al., 2022). The following subsections describes the mechanisms used to ensure validity and reliability was observed.

3.9.1 Data credibility and dependability

In order to establish credibility and dependability, the participants in the research should be identified and described accurately (Daher et al., 2022). In this study, the researcher decided to observe and interview the secondary school mathematics teachers at the selected MCA schools in Ohangwena Region. In this study, the researcher described the participants by indicating the schools they represent, their ranks, genders, and fields of specialization.

3.9.2 Transferability

Transferability refers to the reasoning that findings can be generalized or transferred to other groups of participants or settings. The transferability increases when we give clear descriptions of the context, selection, and characteristics of participants (Daher et al., 2022). In this study, the researcher tried to take care of transferability by detailing the research setting as well as the descriptions of the participants. Transferability is also guaranteed when we show how we analyzed the collected data (Daher et al., 2022). This is described in Chapter 4 of the present research.

3.9.3 Conformability

The conformability of the data means the extent to which the findings accurately represent the information that the participants provided and to which the interpretations of those data are not invented by the inquirer (Daher et al., 2022). In the present study, the researcher verified the responses given by the respondents and developed data sets that were analyzable. At the end of the data collection, the researcher provided a summary of the research and asked the respondent if the summary accurately reflected their positions.

3.9.4 Authenticity

Authenticity refers to the extent to which the researchers fairly and faithfully show a range of realities (Daher et al., 2022). In this study, the researcher followed, in her analysis, different qualitative studies, which also enriched the authenticity of the data analysis.

3.10 Research ethics

Research ethics are sets of principles to guide and assist researchers in conducting ethical studies (Fiesler & Proferes, 2018). Research ethics are focused on what is morally accepted or not accepted when engaging with the research participants or when accessing archival data. The researcher applied some of the facets of ethical research as follows:

3.10.1 Permission to Conduct Research

Firstly, the researcher obtained an ethical clearance certificate from the research and publication office of the University of Namibia (UNAM) to proceed with the study.

Secondly, the researcher sought approval from the executive director of the Ministry of Education, Arts, and Culture and from the Ohangwena Regional Education Director as well as the school principals of the schools under the study.

3.10.2 Informed consent

The participants were informed about the purpose of the research. This included what their role would be and how the trial worked. The participants signed informed consent forms and had the opportunity to ask questions, understanding their roles in the study. Obtaining consent required open and honest communication between the researcher and the participant.

3.10.3 Anonymity and confidentiality

For reasons of anonymity and confidentiality, the names of the teachers who participated in the study were not revealed, and each participant was assigned a pseudonym. They were also assured that the information obtained from them would be for research purposes only and would be treated with the utmost confidentiality. The information that the participants provided was kept strictly confidential on the researcher's personal computer, with the password known only to the researcher. The data will be kept safely for three years before being destroyed by deleting the file with the data from the computer.

3.10.4. Non-maleficence and beneficence

This principle refers to the treatment of research participants and is concerned with appropriate conduct and virtuous living (O'Donoghue, 2022). This study involved human subjects, and as such, special precautions were taken to protect the rights of

these human beings. The researcher ensured that the research did no harm to the participants. This was ensured before, during, and after the research. All the COVID-19 protocols were observed during the collection of the data to make sure that the transmission of the virus was prevented. Data was filed and kept safe; therefore, the researcher does not foresee any harm.

To uphold the principle of beneficence, the main aim of the researcher should be to produce results that will be beneficial to individuals and the entire society (O'Donoghue, 2022). The benefits of the study were made clear to the participants prior to the study. A clear measure of whether the risks involved would outweigh the benefits was made. The researcher got a certificate from the office of research and publications at the University of Namibia (UNAM) that said the research was ethical.

3.10.5 Justice

The principle of justice includes the participant's right to fair treatment and privacy, which should prevail before, during, and after their participation in the research study. (Fiesler & Proferes, 2018). In this study, the participants were treated with respect and dignity. They were informed that they were free to ask the researcher for clarification on anything they did not understand and that, should they wish to withdraw from the study, there should be non-prejudicial treatment.

3.11 Chapter summary

This chapter provided an overview of the research methodology, study population, and sampling used in the study. Other issues discussed include methods and instruments used for data collection and data analysis methods. Ethical issues that were adhered to

by the researcher were also discussed. The next chapter will discuss the research findings and discussions.

CHAPTER FOUR: PRESENTATION AND DISCUSSION OF FINDINGS

4.1 Introduction

This chapter presents the findings and discusses them. The chapter starts with the biographies of the participants and then presents the findings about the level of ICT integration in the teaching and learning of mathematics and challenges to ICT integration at the MCA schools. The chapter further presents discussions of the findings of the study.

4.2 Biographies and background information of participants

Six secondary school mathematics teachers from three MCA secondary schools in the Ohangwena education region participated in the study. Table 4.3 shows the demographic information of secondary school mathematics teachers at MCA Schools.

Table 4.1. Demographic information of secondary mathematics teachers at MCA schools

Schools	Teacher Code	Gender	Rank	Field of specialization
A	TA1	Female	Teacher	Mathematics and Economics
	TA2	Male	HOD	Mathematics and Integrated Natural Sciences
B	TB1	Female	HOD	Mathematics and Physical science
	TB2	Female	Teacher	Mathematics
C	TC1	Male	Teacher	Mathematics
	TC2	Male	Teacher	Mathematics and Biology

There were three male teachers and three female teachers who participated in the study. Two of the participants were heads of departments for mathematics and science

at their schools. The teachers are given pseudonyms linked to their schools; for example, the teacher who was the first to be observed and interviewed at school A is given the pseudonym TA1, to denote the first teacher at school A.

4.3 Presentation and Discussion of Data

Data were collected using classroom observations and individual teacher interviews to answer the three research questions: (1) What is the teachers' level of ICT integration of mathematics in MCA schools in Ohangwena Region? (2) What challenges impede the integration of ICT in the teaching of mathematics at MCA beneficial schools in the Ohangwena region? (3) How can the problems with integrating ICT in MCA schools in the Ohangwena Region be solved? The researcher observed twelve mathematics lessons. Each of the six teacher-participants was observed twice and the observation sheet was used. In this sheet, the researcher took note of the ICTs used and how it was used in every lesson for classroom instructions such as, giving notes, assessment activities and feedback that is relevant to the topic of the lesson. The observed information was used in determining the level of the teachers' ICT integration using the SAMR model. In the interview, the recording device and interview guide was used, of which standardized questions were asked to each participant. After the interview, the interview checklist was then used to help the researcher answer the first question of the study. The check list contains random information of how ICTs are used at different SAMR model levels. The researcher ticks an appropriate box and determine the SAMR level of each teacher from the recording. The information from observation sheet and interview check list was then combined in order to finally determine the overall SAMR level of every participant.

The other part of the interview was used in order to answer questions two and three of the study. The overall information obtained from observations and interviews was then put into themes and concepts based on what was found about each question of the study as show in the table below.

Table 3.2. Themes and concepts

THEMES	CONCEPTS
Theme 1: Teachers' level of ICT integration of Mathematics in MCA schools in Ohangwena Region	Sub theme 1.1: Teachers at substitution
	Sub theme 1.2: Teachers at augmentation
Theme 2: Challenges impede the integration of ICT in the teaching of mathematics at MCA beneficiially schools	Sub theme 2.1: Lack of ICT integration skills
	Sub theme 2.2: Lack of time to integrate ICT
	Sub theme 2.3: Inadequate ICT tools
	Sub theme 2.4: Lack of technological support
	Sub theme 2.5: Language challenge
	Sub theme 2.6: Lack of teachers specialized in ICT
	Sub theme 2.7: Lack of related guidelines and teaching aids for ICT integration
	Sub theme 2.8: Lack of collaborations
Theme 3: Strategies that can be used to overcome the challenges of ICT integration in the MCA schools	Sub theme 3.1: Provision of professional development opportunities to teachers.
	Sub theme 3.2: Provision of ICT tools
	Sub theme 3.3: Provision of teaching media related to ICT
	Sub theme 3.4: Employ IT technicians at schools
	Sub theme 3.5: Employ ICT teachers at schools

4.4 Theme 1: Teachers' level of ICT integration of mathematics in MCA schools in Ohangwena Region

The information about the teachers' level was found from the observations and interviews made. The following subsections present these findings.

4.4.1 Sub-theme 1.1: Teachers at Substitution

It was observed that the secondary school mathematics teachers minimally integrating ICTs in their lessons. The table below represent the combined observed information.

Table 4.3. The summary of the observed data

Class task	TA1	TA2	TB1	TB2	TC1	TC2
Giving of Notes to learners	Typed, Printed and duplicated	Duplicated	No ICT involved	Duplicated	Duplicated	No ICT was used
Giving assessment activities	Duplicated	Typed, printed and duplicated	Duplicated	Typed, printed and duplicated	Typed, printed and duplicated	No ICT was used
Giving Feedback to learners	No ICT was used	No ICT was used	No ICT was used	Typed, printed and duplicated	Typed, printed and duplicated	No ICT was used
ICTs involved	Computer, printer, photocopy machine	Computer, printer, photocopy machine	photocopy machine	Computer, printer, photocopy machine	Computer, printer, photocopy machine	photocopy machine
SAMR level	Substitution	Substitution	Substitution	Substitution	Substitution	Substitution

The teachers mostly relied on textbooks and the chalkboard. Most of the class instructions were given orally. Some teachers used printed materials for giving notes, assessment activities, and feedbacks that are relevant to the topics and lessons presented. The printed materials are those that the teachers typed, printed, or made copies from sources like textbooks and duplicated enough for all learners in the class. They were then ranked at the substitution level of SAMR model.

Information from the interviews indicated that all the participants are at substitution level too as they indicated that they only substitute technology with their normal ways of teaching. They were asked to state how they use the ICTs provided in their schools into the teaching of mathematics based on giving topic related notes, assessment activities and feedbacks given to learners, and this is what they said;

TA1 has this to say: *"I use ICTs to type, print and make copies." I type my lesson plans, learners' notes related to the content to be discussed and learners' activities.* TA2 said that *"I use the computers to type and save all my schoolwork, like lesson plans and learners' notes and activities copies are made enough for all learners."* In addition, TB1 said, *"I only use a computer to type and a photocopy machine to duplicate topic notes, exercises and topic tests, for learners. I also make copies of learners' feedback when I see there is not enough time to explain using the chalkboard"*. Further, TB2 stated the following; *"In order to save time, I use a computer to type and a photocopy machine to duplicate all the notes, exercises, corrections and any other activity that I give to my learners"*. Moreover, TC1 said the following: *"I use all the tools supplied to us. For instance, I use the overhead projector and laptop to present my lessons on Power Point. The learners' notes and assessment activities are sometimes downloaded, printed and duplicated for each of the learners and then presented on the overhead projector"*. Lastly, TC2 highlighted that *"I use Google to search for information on the web. I download notes related to the topic that I want to present, and make copies for all learners."*

The information observed and that provided by participants show that, the teachers directly substituted traditional methods with technology.

Therefore, they are ranked at the substitution level of the SAMR model. According to Hamilton et al. (2016), a teacher is ranked at the substitution level if technology is used as a direct tool substitute with no functional change. For instance, a teacher replaced a traditional method (such as writing on the chalkboard, a handwritten poster or flip chart, or a textbook) with ICTs (such as an overhead projector, computer, soft or hard copies, or a video). The findings of this study agree with the finding of Kihoya

et al. (2016), who in their study found that teachers are at the substitution level of ICT integration in the SAMR model because they are found directly substituting manual methods with technology.

4.4.2 Subtheme 1.2: Teachers at Augmentation

There were no activities that were observed at the augmentation level during the lesson presentations. However, from the interviews, the study found out that four of the participants substituted technology with some improvements. During the interviews, the participants were asked to state how they were using the available ICTs in their mathematics lessons. The participants indicated that they used the internet to search for learning contents such as videos that aided them in presenting their lessons and allowed learners to practice after watching the videos. The following claims by the participants substantiate this claim:

TA1 stated the following: *“I download the videos that contains the full presentation of any topic that I will present on the projector. From the videos learners sometimes make their own notes. Due to COVID -19, I also sent content related notes, exercises and voice noted feedback to a WhatsApp group that was created during the teaching and learning from home sessions”*.

TB1 said, *“ I also use my phone to connect to the internet provided in order to download videos that we watch with learners on the projector, and then I ask them to practice what they learned.”*

In addition, TB2 contributed by saying the following: *“I use the internet to search for videos with examples that I watch and then take notes that I will*

present to learners, using PowerPoint on the overhead projector. I also let learners search and present the topics to others".

TC1 highlighted the following: " Sometimes I search for videos on the internet, present to learners on the projector. I also sent my learners to the library to search for information such as methods and examples of the learned content that they could come and present to class and allow them to provide the link from where they found information. In some cases when time is limited, I type and duplicate the feedback for learners to share"

The teachers who improved on the substitution level are ranked on the augmentation level of the SAMR model. For a teacher to occupy the augmentation level, the technology should be used as a direct tool substitute but with functional improvement (Puentedura, 2014). For instance, after watching a video, the teacher then allows learners to practice solving the problem using calculators or a spreadsheet (Robinson, 2017).

The study then found out that all the participants are at the substitution level and four of the participants are at the Augmentation level. The table below shows the combined data from observations and interviews.

Table 4.4. The summary of observed and interviewed data

Class task	TA1	TA2	TB1	TB2	TC1	TC2
Giving of Notes to learners	Typed, printed and duplicated videos	Typed Printed duplicated	Typed Printed duplicated	Typed Printed duplicated Projected	Typed Printed duplicated Projected	Printed duplicated
Giving assessment activities	Duplicated	Typed, printed	Duplicated	Typed, printed and duplicated	Typed, printed duplicated	Duplicated

		and duplicated			Searched, projected	
Giving Feedback to learners	Sent on WhatsApp	No ICT was involved	Duplicated	Typed, printed and duplicated	Typed, printed and duplicated	No ICT was used
ICTs involved	Computer, printer, photocopy machine internet Overhead projector	Computer, printer, photocopy machine	Computer, printer, photocopy machine	Computer, Printer, photocopy machine Internet Overhead projector	Computer, Printer, photocopy machine Internet Overhead projector	Printer Photocopy machine internet
SAMR level	Substitution and Augmentation	Substitution	Substitution and Augmentation	Substitution and Augmentation	Substitution and Augmentation	Substitution

There is no evidence showing any teacher occupying modification or redefinition levels of the SAMR model. This then means the mathematics teachers at the MCA schools in Ongha circuit of Ohangwena region occupy the Substitution and the Augmentation levels of SAMR model. The result concurs with several studies that revealed that their participants were ranked at the enhancement levels of the SAMR model (Budiman et al., 2018; Jude et al., 2014; Tunjera & Chigona, 2019). Substitution and augmenting levels of the SAMR model in ICT integration are together categorized as levels of enhancement (Kidder et al., 2014).

4.5. Theme 2: The challenges impede the integration of ICT in the teaching of mathematics at MCA beneficial to schools

The participants were asked to state the hindrances to the use of ICTs equipment that they encounter during the mathematics lessons. They outlined challenges to the integration of ICT into their teaching of mathematics as lack of integration skills, inadequate time to integrate ICT, inadequate ICT tools, and a lack of assistance in case

of technological failure. Language challenges, a lack of teachers specialized in ICT, lack of related guidelines and teaching aids for ICT integration, and as well as lack of collaboration were also outlined as challenges to ICT integration in MCA schools.

4.5.1 Subtheme 2.1: Lack of Integration Skills

All the participants indicated that they have no adequate ICT integration skills. For instance, TA1 stated this; *“We are provided with all the ICTs that we may need, but the skills to use them into the subject content is lacking. So, I only use basics as they are the ones that I am comfortable with.”*

In addition, TA2 agreed with TA1. He said; *“We only have knowledge to use ICTs such as typing, printing, photocopying, but to deeply use this into subject contents is not easy as that knowledge is inadequate.”*

TB1 and TB2 concurs with TA2. They said that they only have the basic skills of using the ICTs. Further, TC1 had this to say; *“I have inadequate integration skills as I can only fully integrate a few topics in mathematics”*. Finally, TC2 like TC1 has inadequate ICT integration skills. He said the following; *“All I can do with ICTs is minor things like typing, printing, and searching for videos. I think I still need more skills as what I can do now is at a low level.”*

The review on this study revealed that MCA has given training on the use of ICTs provided to MCA schools. This then made the researcher to have interest in following up in order for the participants to state what they learned from this training. This study then found out that five secondary school mathematics teachers were not part of the MCA training because they were not at their current schools during the training. Even though they did not receive training from MCA, they indicated that they learned some

ICT skills during teacher training at the teacher training institutions. Some participants also indicated that they went through the ICDL program, which was sponsored by Tech/Na. The following supported these claims;

The participants TA2 and TB2 indicated that apart from the training on the use of ICTs from the institution of high learning, they also attended the ICDL program and further attended workshops on how to integrate ICT in classrooms. However, they still feel it was not enough to state that they have adequate integration skills. For instance, TA2 said: “ I got ICTs integration skills but I cannot use it much and deeply in all the topics, only basics. Should I say I have adequate skills?” In addition, TB1 stated the following; *“I got ICT integration skills at the university but were too little to be able to fully integrate ICT in all the topics mathematics.”*

Teacher TC1 said, *“The training given at workshops was all about designing graphs using computers and setting up questions, but it was not in all topics.” It was more based on the topic of “graphs and functions.”*

TC1 and TC2 made their contributions based on the guidelines. They both claimed that they were not provided with clear guidelines on the methods to integrate ICT in teaching and learning processes. TC1 said; *“At the moment, there are no guidelines that stipulates how to integrate ICTs in our subjects.”* TC2 added that *“We are not given training on the methods to integrate ICT. I expected to have teachers’ guides on the ICT integration in all the promotional subjects.”* Finally, participant (TA1) got MCA training at another MCA school in another region on how to use the provided tools and this is what she has to say;

"The MCA showed us how to operate the ICTs, like turning them on and off, as well as the safe keeping and storing of the ICTs. They further focused on basics on how to use phones and tablets in the class."

The findings of this study revealed that the participants have prior knowledge of the ICT integration in teaching and learning of mathematics. However, they felt that they did not have sufficient skills to integrate ICT in their teaching of mathematics. Participants also indicated that there is no clear indication provided on how to use ICTs to help learners learn, and this makes it very difficult to integrate ICT when teaching mathematics. These findings concur with that of the study of Zakaria and Khalid (2016), who revealed that teachers were unable to integrate ICT in their lessons due to poor or a lack of integration skills. In their study about the use of ICT in the teaching of mathematics in Ghana, Agyei and Voogt (2011) also agrees with the findings above. They found that a lack of guidelines, understanding about methods to integrate ICT in lessons and a lack of training opportunities for ICT integration knowledge acquisition are some of the challenges that mathematics teachers face. Further, the findings above are also closely connected to those by Babbie (2014), who indicated that teachers in most schools are underequipped in terms of skills and knowledge to make use of digital technology tools in schools during teaching and learning. The lack of digital technology skills and ICT pedagogical knowledge discourages teachers from using digital technology in their classes. The integration of ICT in the teaching of mathematics at MCA schools cannot be effective if this obstacle is not addressed.

4.5.2 Subtheme 2.2: Lack of time to integrate ICT

All the participants stated that ICT integration in the teaching of mathematics hardly takes place in their schools because of lack of time. For instance, TA1 said,

"There are a lot of contents we need to cover, for instance, for grades 10 and 11." ICT integration requires a lot of time. So, if I have to always integrate ICT, I might not finish all the contents by the end of the 11th grade academic year."

TB2 further indicated that ICT integration requires a lot of time as the teachers need to train learners on how to use the devices first. For instance, she said,

"ICT has a lot of issues that need attention." For instance, language issues and technical issues. For language issues, one needs to make learners understand ICT language for them to cope. For technical issues, computers sometimes have viruses or corrupted systems that make it hard for them to operate quickly. "All these waste time."

TC1 also supported the above claims by saying, *"There is just a lot to cover in a short time; for instance, a lesson has 40 minutes, which is not enough for presentation and setting up of ICTs to be used."*

Three participants stated that the integration of ICT using computers and overhead projectors wastes time as they are not allowed to move these devices from the computer laboratory. The following claims from these participants substantiate this claim:

TA2 said that *"Portable devices such as learners' laptops are not allowed to be taken out of the laboratory. We then have to book for that class if we want to use them. That is time wasting."*

TB1 said *“Only photocopying can save time. The other provided devices require us to waste time because one has to move to the computer laboratory where they are found as they cannot be moved to our classrooms.”*

TC2 in support of TA2 and TB1 said this:

“The computer laboratory is used as a classroom too. It then has to be booked as it is not always unoccupied. The act of waiting for others to use, wastes time. It could be better if we were allowed to bring these ICTs to our classrooms.”

Finally, TB1 stated that internet provided is only accessible in classes that are close to the administration block. She said *“if one wants to use internet during the lesson, she or he has to move close to the admin block this surely wastes time.”*

The above finding concurs with the findings of Simon & Ngololo (2018) who also talked about the lack of time for teachers to integrate ICT as they have overcrowded course outlines that they are expected to cover in a short time. They further added that insufficient time due to the overburdened timetable and other school responsibilities hamper teachers' ability to take out time for searching the internet and using computers as teaching aids. Abhilasha et al. (2019); Apeanti (2016); and Das (2019). In both of their studies also revealed that a lack of time exists in many aspects of teachers' work as it affects their ability to complete tasks, as they need to avail time to locate internet advice, prepare lessons, explore and practice using the technology, and also to deal with technical problems.

4.5.3 Subtheme 2.3: Inadequate ICT tools

Even though not every learner needs to have a computer, the participants stated that the provided learners' laptops are very few, and some of them are no longer functioning. Four of the participants highlighted that the ICTs provided are not enough to be used by every teacher at the same time. For example, TA1 said,

"The computers provided at our school are too few in relation to the computer learner ratio. Three teachers cannot use these computers at the same time. Some of them are no longer functioning. Lastly, only one overhead projector is provided for the whole school."

In addition to this, TB1 said *"We are lacking ICT-Friendly classrooms. The laboratories we have here were just classes, and they are still used for other lessons. So, for us to use them, we need to book for them and this is discouraging."* She added on saying *"most of the available computers are not even functioning and only a few that are usable."*

Further, TC1 agrees with the others, and he made the following contribution:

"Even though we are provided with computers, some of them are not functioning anymore, and they were never repaid." "The ones that are left are too few, so I do not involve learners much. Isn't ICT integration supposed to include both teachers and learners, right?"

The above findings concur with Gupta and Gupta (2011) who also found that teachers have trouble integrating technology into teaching and learning in the classroom because they do not have enough ICT resources. The findings were also supported by

Amuko (2015), who revealed that the non-functionality of some ICT infrastructures leads to inadequate facilities and thus discourages teachers from teaching with the use of ICT in mathematics. Furthermore, Ader (2014) also found out that low numbers of computers, the oldness or slowness of ICT systems, and the scarcity of educational software in the school were barriers to the successful implementation of ICT in Turkish schools.

Two of the participants highlighted that the internet provided is of a short radius and cannot be accessed in most of the school classrooms. The following claim from the participants back this claim:

TB1 said: *“We have a limited internet access. It can only be assessed when one is close to the admin block.”*

TB2 has this to say *“Sometimes I use the data on my phone when I need to search for something while at the class. We have a very short-ranged Wi-Fi stand. What if I don’t have the data? This is too discouraging.”*

Limited internet access restricts teachers from making use of internet resources at schools; for they know, they will waste time by keeping changing positions to make sure they get a full coverage, which will allow them to search for information (Kihiza et al., 2016). In addition, Ngussa & Gundula (2019) say that high-speed internet access is one of the crucial aspects of the uptake and use of such educational technologies in schools, and therefore, schools should be provided with such internet for teachers to be able to access it wherever they find themselves in the school.

4.5.4 Sub-theme 2.4: Lack of assistance in case of technological failure

Four of the participants indicated that technology failure also limits them from integrating ICT in their lessons. For instance, TB1 said, *"Some computers that malfunctioned are never repaired, but it could be better if we had an IT person to assist in this case"*

TA1 and TC1 expressed disappointment as far as technical support is concerned. They said they do not rely on anyone for technical help. TA1 said:

"Sometimes when the computers or other ICTs are malfunctioning, we wait to see if they will work." This is because we are not aware of what the problem is. "We just do not have anyone to help us, and this is too discouraging."

TC1, also said, *"We do not have the digital technology facilitator, although the computers are fully available in the school laboratory."*

TC2 also added that they do not have the technical knowledge to determine whether a computer has been broken or infected by a virus or any other type of infection. For instance, TC2 said, *"If anything happens that these ICTs are not functioning, no one has the courage to look at what is happening as we do not have any knowledge about the causes, prevention, or repair of ICTs."*

The results gave a clear indication that the MCA schools under the study do not have personnel appointed as IT or computer specialists that could assist them when any technological or technical failure is observed while integrating ICT in any lesson. The finding also revealed that mathematics teachers realize the need to have a computer specialist. The specialist is needed not only to help them with the ICT integration, but also to identify ICT failures, find proper software needed for integrating ICT in all

subjects, and be accountable for the ICT facilities in the school in order to make sure the ICT tools are efficiently maintained.

Other studies also revealed that a lack of or inadequate technological support while using ICT tools, providing teachers with reasons not to integrate ICT in their lessons (Abhilasha et al., 2019; Amunyela, 2020; Apeanti, 2016; Das, 2019). In addition, this study findings also agrees with Rwodzi et al. (2011), who stated that some schools that benefited from donated computers have not been adequately equipped with the same for maintenance and repair. Finally, according to Nchindo (2019), technical support and technical skills are fundamental components for integrating ICT in teaching and learning. He further stated that technical personnel have a better understanding of the language used in the ICT world than the academic staff, which will make life easier for the learners.

4.5.5 Sub-theme 2.5: Language Challenge

The findings of this study revealed that language also discourages the participants from using ICTs in their lessons. Four of the participants stated the following:

TA1 said that ICT language on its own is difficult to translate to learners. For instance, she said, *"ICT language discourages us from using ICT." This is because we first have to train learners to understand ICT before using it. See, for instance, "mouse or window in English and in ICT, they are completely different."*

In addition, TA2 felt that the accents used in videos that are presented on YouTube can confuse learners and also make it hard for teachers, as they have to keep translating by repeating what the video presenter has stated. He said, *"We have a problem with language." Learners are already unable to understand our accents. Integrating ICT*

by bringing videos from the internet might confuse learners, as sometimes the accent used in videos is hardly understood by them."

TB2, in agreement, also contributed by saying the following: *"Downloading videos to use in lessons requires the teacher to translate time by time."*

TC1 also revealed that the medium of instruction on its own is also a challenge, as learners already find it hard to cope with it in lesson instructions. He said, *"Learners already fail to understand when we teach in English." All ICT contents are presented in English too; therefore, having to integrate ICT is a burden on its own."*

In this study, results revealed that language usage is one of the challenges to ICT integration in their lessons. The findings of this study concur with the findings of other studies that found that the medium of instruction may lead to a lack of or low ICT integration, especially when one is not well fluent in it (Otieno, 2018; Thi, 2020).

4.5.6 Subtheme 2.6: Lack of teachers specialized in ICT

The study also revealed that the schools do not have ICT teachers who are specialized to teach ICT. The following claims from the four participants sustain this claim: TA1 said, *"We do not have teachers who are specialized to teach ICT in our schools." "The presence of ICT teachers is of most importance, as they could help us to ease the use of ICT, as learners will have some knowledge of ICT tools."* In addition, TA2 contributed by claiming that,

"Teachers who are expected to teach ICT in our schools specialize in other subjects like commerce and science." "They cannot help us much as they are also not equipped and trained in teaching ICT; they seem to concentrate more

on only teaching their subjects of specialization as these are required for promotions."

Further, TB1 said, *"We do not have an ICT specialized teachers in our school, but she or he is needed to help not only learners but also teachers who are struggling in the use of ICT."*

Finally, TB2 said, *"We need ICT teachers in our school."*

This finding of the study concurs with the finding of some researchers that stated that, with the lack of ICT teachers in school, other teachers cannot help learners to understand and use the language better, which increases the failure of learners to understand the integration of ICT in other subjects (Okumura, 2017; Otieno, 2018).

4.5.7 Sub-theme 2.7: Lack of related guidelines and teaching aids for ICT integration

This study also revealed a lack of appropriate software and a lack of teaching aids and guidelines to assist teachers in the integration of ICT in their lessons as some of the challenges to ICT integration in their lessons. The claims below from the four participants support this claim. TA2 said,

"We lack teaching aids for ICT integration." Even though we have hardware, there is no appropriate software for integration. There are also no teaching aids such as textbooks or even guiding documents such as assessment guides that stipulate how learners are assessed with the use of ICTs in our subjects.

In addition, TB1 added that guiding documents related to the ICT integration into teaching are not available. Further, TB2 said, *'There are no guidelines that one can*

follow in order to integrate ICT'. In support is TC1, who said, "The ICT policy did not come with any other supporting document to help in integrating ICT into any subject."

The above findings are a true replica of the findings by Rani and Anisha (2018) and Thi (2020), who both concluded that the integration of ICT in any subject cannot take place if teachers are not fully supported in terms of teaching aids, software, and guiding documents. These findings also concur with those of Barakabitze et al. (2019) and Martin & Nobis (2021), who stated that related guidelines and teaching aids for ICT integration are lacking in most of the African countries.

5.5.8 Subtheme 2.8: Lack of Collaborations

The results of this study reveal that the mathematics teachers at MCA schools lack collaboration within themselves as well as with other educational stakeholders. The following claims from four of the participants anchor this claim:

TB1 said, *"Everyone is doing his or her own thing." "We hardly meet to engage in things that are based on the teaching and learning with ICT."*

In addition, TB2 said, *"There are few invitations to workshops based on ICT." Such workshops mostly invite teachers who are assigned to teach information communication at schools, and these teachers hardly share the knowledge acquired from the workshop with us."*

TC1 as well said, *"We do not have connections with other teachers or other stakeholder groups; I feel like we are on our own when it comes to ICT integration."*

Finally, TC2 summarized by saying, *"The integration of ICT cannot take place with ease because we lack collaboration with each other."*

The finding above indicates that teachers lack collaboration with others, and this alone could hinder the integration of ICT, as it seems teachers do not have any platform to share ideas. It is through professional development activities and programs that teachers can work together and has a high opportunity to discuss concepts, skills, and problems that they are facing in teaching processes (Yamanmoto & Yamgauchi, 2019). It is also believed that training activities promote teacher collaboration through hands-on experiences in creating digital teacher training and classroom teaching materials (Li et al., 2019). In support of teacher collaboration, Genlott & Grönlund (2016) stated that the integration of ICT in teaching and learning processes requires teachers and other stakeholder groups to join hands.

4.6 Theme 3: Strategies that can be used to overcome the challenges of ICT integration in the MCA schools

The participants were asked to state about what they think should be done in order to resolve the problems with integrating ICT in their schools. They highlighted the need for the provision of professional development opportunities to teachers; provision of adequate and reliable ICT facilities; provision of teaching media related to ICT, employ IT technicians and employ ICT teachers at schools.

4.6.1 Sub-theme 3.1 Provision of professional development opportunities to teachers

The training of educators helps provide adequate skills to trainees. In order to function as computer-literate facilitators in a school, teachers should be given adequate and related ICT training (Gray, 2014). Four of the participants indicated the need for training opportunities in ICT integration in mathematics classrooms. All the participants suggested that MoEAC should provide in-service training for teachers to

be able to gain knowledge on how to integrate ICT into the subjects they teach. The following citations anchor this claim:

TA1 said, *"We should be provided with more ICTs and more workshops."* *"We lack the knowledge on how to integrate ICTs in the teaching process."* In addition, TA2 agreed saying, *"More workshops can help us gain more knowledge; therefore, the MoEAC should look into that to ensure that we are able to implement the ICT policy."* Further, TB1 in support of others said, *"MoEAC should provide money for workshops where teachers can be equipped with knowledge of ICT integration in the subject they teach."* Moreover, TB2 contributed by saying, *"MoEAC should just provide opportunities and workshops for relevant ICT knowledge."* Finally, TC2 in support of TB2 said, *"Relevant ICT knowledge and guidelines for ICT integration are all we need to be trained on."*

The study revealed inadequate CPD on ICT. Therefore, there is a need for the provision of relevant training and training opportunities, as well as guidelines for teachers (Nchindo, 2019). Maryuningsih et al. (2020) also found that good ICT skills in prospective teachers provide a great opportunity to apply learning with good ICT skills input for learners, therefore, a need to for all teachers to be equipped with good ICT skills.

4.6.2 Sub-theme 3.2: Provision of adequate and reliable ICT facilities

This study revealed a need for ICTs that are easily accessible and for infrastructure that is ICT friendly. Four of the participants suggested that the schools should be provided with adequate ICT facilities that are reliable that can cater for the large numbers of learners in their classrooms in order to help them to integrate ICT with ease. they stated the following;

TA1 said, *“we should be provided with more computers and at least three overhead projectors.”* TB1 added on by highlighted that there is a need to improve all classrooms to be ICT friendly. For instance, she said: *“MoEAC should first consider all infrastructure; the classes must be set to a standard that a teacher can be able to use ICTs during the lesson presentations.”*

further, TC1 stated, *“The ministry should provide ICT tools that can be shared in a reasonable ratio; for instance, a maximum of two learners per computer. We have large numbers of learners in our classrooms.”*

Moreover, TB1 and TB2 suggested that the whole school should have internet coverage. For instance, TB1 said, *“There must be internet access in all the classrooms in the school.”*

Finally, TB2 then said, *“We should be able to access internet in every point of the schools we found ourselves. Be it sport field, garden or science lab.”*

This finding concurs with Gupta & Gupta (2011), who stated that in teachers should be provided with enough ICTs to prevent them from frustrations and excuses for to not Integrate CT. Similarly, Ader (2014) also suggested that and the government needed to find ways to ensure adequate equipment for teaching and learning processes with ICT .

4.6.3 Sub-theme 3.3: Provision of teaching media related to ICT

The findings of this study revealed a lack of teaching media related to ICT as a challenge to ICT integration. The teachers indicated the need for the provision of appropriate software, guideline documents, and related teaching aids that they can use to make sure ICT integration is taking place in all their lesson presentations. The

following citations from four of the participants support this claim: TA1 said, "We need guidelines that can help us integrate ICT into our subjects." TB2 added, "At least provide any document that can guide us on how to integrate ICT in our subjects." Also avail proper software." TC1 also contributed by saying, , "I think MoEAC should provide us with an assessment guide based on ICT integration in our subjects." TC2 stated that

"We need all ICT-related guidelines and teaching aids in order to fully integrate ICT into our lessons." "The policy should have supportive documents, and if it is possible, mathematics textbooks should also have some areas where this cross-curriculum issue is addressed."

This finding concurs with that of Holloway (2015) and Ngeama (2018), who stated that there is a need to provide for ICT software and teaching aids as well as supportive documents to guide teachers in the integration of ICT. In addition, Barakabitze et al. (2019) and Martin & Nobis (2021) stated highlighted that most developing countries face a challenge with ICT integration due to a lack of appropriate teaching material on the ICT side, and therefore, need to be assisted in this regard.

4.6.4 Sub-theme 3.4: Employ IT technicians at schools

According to Das (2019), the availability of malfunctioning computers in schools is a result of lacking technical skills to have them fixed a skill that all institutions sorely require whenever working with digital technology tools. This study reveals the need for schools equipped with ICTs to have a technical support official who should always be available to make sure the teaching and learning processes take place with ease with the use of ICTs. The citation from the three participants below authenticates this claim:

TA1 said, *"The MoEAC should provide a person specialized in ICT in order to help the teachers when they are unable to or are struggling with the ICTs." We cannot integrate ICT if the computers are malfunctioning, as it wastes time.* TB2 said, *"The schools that are provided with ICTs should also be provided with ICT technicians."* TC2 contributed by saying, *"For proper maintenance of ICTs provided in schools and for a high level of ICT integration in these schools to take place, the MoEAC should employ IT technicians per circuit, if not per school."*

The finding in this study revealed the need to have technical personnel to assist when the need arises. This concurs with the findings that state that there has to be one or two technical experts at each school from among the local staff or someone who is independent, depending on the financial muscle of the school (Gray, 2014). The technical personnel are needed not only for solving issues with connectivity and technical flaws of the hardware alone but also for maintenance and to make sure that the whole system can work and be managed. (Nchindo, 2019).

4.6.5 Sub-theme 3.5: Employ ICT teachers at schools

According to Okumura (2017), the availability of specialist teachers in schools helps with ICT integration as they possess high expertise in teaching their subjects. They are also aware of barriers and strategies to mitigate them (McLinden et al., 2016). The findings of this study revealed the need for schools to have teachers who specialize in teaching ICT. The following suggestions from the four participants anchor this claim:

TA1 said, *"MoEAC should look into employing teachers who are specialized in teaching ICT." This is of most importance as it makes teachers' work easier as learners will already be familiar with some of the ICT concepts."*

TA2 added by stating that *"We need qualified ICT teachers at schools so that they can help us in terms of planning for presentations."* Further, TB2 contributed by saying, *"Having teachers who are specialized in teaching ICT at school is a favor to us."* Finally, TC1 is also in support of the provision of qualified ICT teachers in schools. He said,

"Specialized ICT teachers will help us, especially in the use of language."

"Learners will be more aware of the language used in ICT, and even the medium of instruction will no longer be a barrier to ICT integration as learners will become fluent little by little."

The above finding concurs with the finding by Nchindo (2019), who stated that specialist personnel are needed not only to assist in computer issues but also to assist in the teaching and learning processes.

4.7 Chapter summary

This chapter presented the findings from the observation and interviews with the participants. The findings were presented in the form of emerging themes, which were aligned to answer the research questions of the study. The findings were discussed in depth, and literature was used to support them. The next chapter presents a summary of the study, recommendations, and room for further research.

CHAPTER FIVE: SUMMARY, CONCLUSION, AND RECOMMENDATION

5.1 Introduction.

This chapter unpacks a summary of the study, the inferences, recommendations, and areas for further research. The main purpose and aim of the study were to assess the mathematics teachers' level of information and communication technology integration at MCA-schools in Ohangwena region in Namibia. The study used a qualitative descriptive research approach or methodology and design using observation and a standardized face-to-face interview, which was administered to six secondary school mathematics teachers who were purposefully selected from Ongha Circuit, Ohangwena Region, Namibia.

The study sought to answer the following main research question:

1. What is the teachers' level of ICT integration in mathematics in MCA schools in Ohangwena Region?
2. What challenges impede the integration of ICT in the teaching of mathematics at MCA beneficial schools in the Ohangwena region?
3. How can the problems with integrating ICT in MCA schools in the Ohangwena Region be solved?

Chapter Four bears answers to the questions, where research findings are presented and discussed.

Data was collected, analyzed, and well elaborated on in Chapter Four. Supporting literature and the theoretical framework to substantiate, explain, relate, and contrast the findings of this study were all made use of in this study. The following section will present a summary of each topic as well as conclusions and recommendations based on the study's findings.

5.2 Summary of the Chapters

The summary of the chapters provides a brief account of the principal components of each chapter without giving the fullest details, for they are already enshrined in the chapters themselves.

5.2.1. Chapter 1: Introduction to the Study

This chapter highlights and provides the reader with a general outline and contextual background of the study, the research objectives, the research questions that were to be addressed in the current study, and the significance of the study. It also provided the statement of the problem of the study, the definition of the main functional terms used in the study, and the outline of the thesis. Lastly, this chapter provides a summary of the main aspects dealt with in this chapter.

5.2.2. Chapter 2: Literature Review

The second chapter presented the theoretical framework of the study and a comprehensive review of the literature for the study. This chapter presented the SAMR model and the constructivist theory of learning as the theoretical framework of the study. The reviewed literature in this chapter mainly pivots on teachers' levels of ICT integration in classrooms, the challenges to ICT integration, and the mitigation

strategies to curb the challenges being faced by teachers in the integration of ICT in teaching. Finally, this chapter ended by presenting the strategies to mitigate the challenges being faced by teachers and students during the integration of ICT in teaching and learning in schools.

5.2.3 Research Methodology

This chapter focused on the research methodology of the study, and a qualitative descriptive research methodology was used in this case. The study participants were secondary school mathematics teachers who were purposefully selected from three different secondary schools in the Ongha circuit. Data was collected by means of observations and a standardized face-to-face interview, which were administered to six secondary school mathematics teachers in the Ongha circuit in the Ohangwena education region of Namibia.

5.3 Major Findings

The findings of this study were based on the three research questions as presented in the next sections.

5.3.1 Research question 1: Teachers' level of ICT integration in mathematics in MCA schools in Ohangwena Region

The findings of this study revealed that the secondary school mathematics teachers at MCA schools in Ongha circuit of Ohangwena region are at the substitution and augmentation levels of SAMR model. During their teachings, they tried to construct knowledge in multiple ways using different ICTs provided to them, in addition, they allowed learning to be controlled and mediated by learners as some allowed social interactions with learners, which brings about collaboration. Further, those that sent

learners to the library, allowed learners to bring unique prior knowledge, expectations and beliefs to a learning situation. Therefore, even if they minimally integrate ICT, they are in line with the constructivism theory of learning as they adhered to some of the constructivism principles.

5.3.2 Research question 2: What challenges impede the integration of ICT in the teaching of mathematics at MCA beneficially schools in the Ohangwena region?

The study revealed that mathematics teachers in Ongha circuit secondary schools are facing challenges in their teaching with ICT tools. These challenges are a lack of integration skills; lack of time to integrate ICT; inadequate ICT tools; a lack of assistance in case of technological failure. Other challenges outlined are language challenges; lack of IT personnel and teachers specialized in ICT; a lack of related guidelines and teaching aids for ICT integration; and lack of collaboration.

5.3.3 Research question 3: How can the problems with integrating ICT in MCA schools in the Ohangwena Region be solved?

The study also found out that in order for teachers to effectively integrate ICT in their teaching, the ministry of education must address the following: provide in-service training to teachers and training opportunities; provide ICT tools and ICT-related teaching aids; and provide human resources in terms of ICT personnel.

5.4 Recommendations.

The study makes the following recommendations:

- The study recommends that MoEAC provide funds for in-service training on the integration of ICT in teaching and learning processes in all subjects and

also provide proper guidance in this area. This is in order for teachers to gain an adequate pedagogical understanding of ICT integration.

- The study also recommends that MoEAC provide guidelines on methods for integrating ICT into teaching.

5.5 Suggestions for Further Research

This study was carried out only in one Namibian educational circuit and region. The sample size of participants could be considered as the main limitation of this research and as such, further research should assess the teachers' level of ICT integration in the teaching of mathematics at the other MCA schools at the national level with a large sample.

5.6 Conclusion.

This chapter presented a summary of all the chapters in the study, followed by a summary of the principal findings stemming from the study. It further went on to present some recommendations and leave a yawning gap for further research. A qualitative descriptive research approach was utilized to answer the research questions in this study, thereby achieving the research goals and objectives. The findings of this study provided a penetration into the teachers' level of ICT integration in the teaching of mathematics at the other MCA schools in Ongha Educational Circuit, Ohangwena Region. This very last chapter of the study presented the reader with a summary and the conclusions of the previous chapters, including the introduction, literature review, applied research methodology, and presentation of the research findings.

Recommendations were made to the Ministry of Education, Arts, and Culture, which were brought to light by teachers who participated in the study. Additionally, the

researcher made recommendations for future research in Namibian secondary schools. In conclusion, the study is expected to add knowledge to the limited body of literature on the teachers' level of ICT integration in the teaching of mathematics at the MCA schools in the context of Namibian secondary schools.

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APPENDIX A: ETHICAL CLEARANCE CERTIFICATE



ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: RUC0001 **Date:** 30 August 2021

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 Rundu campus Decentralized ethics committee.

Title of Project: Assessing mathematics teachers level of Information and Communication Technology integration using Substitution Augmentation Modification Redefinition model: A case study of Millennium Challenge Account schools in Ohangwena region

Researcher: Ferdina Pomwene-Pawa Albinus

Student Number: 201309272

Supervisor(s): *Dr Frans N. Haimbodi & Ms Leena N. Kanandjebo*

Centre for Research Services

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.

A stylized signature in black ink.

Dr Emilia N. Mbongo
Chairperson, Ethics Committee

A stylized signature in black ink.

Prof. Davis Mumbengegwi
Head, Multidisciplinary Research

APPENDIX B: RESEARCH PERMISSION LETTER



CENTRE FOR RESEARCH SERVICES

Office of the Pro-Vice Chancellor: Research Innovation and Development
UNIVERSITY OF NAMIBIA, Private Bag, 13301 Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneers Park, Office F224

RESEARCH PERMISSION LETTER

Date: 13/09/2021

Student Name: Ferdina Pomwene-Pawa Albinus

Student Number: 201309272

Programme: MASTER OF EDUCATION

Approved Research Title: ASSESSING MATHEMATICS TEACHERS LEVEL OF INFORMATION AND COMMUNICATION TECHNOLOGY INTEGRATION USING SUBSTITUTION AUGMENTATION MODIFICATION REDEFINITION MODEL: A CASE STUDY OF MILLENNIUM CHALLENGE ACCOUNT SCHOOLS IN OHANGWENA REGION

TO WHOM IT MAY CONCERN

I hereby confirm that the above mentioned student is registered at the University of Namibia for the programme indicated. The proposed study met all the requirements as stipulated in the University guidelines and has been approved by the relevant committees.

The proposal adheres to ethical principles as per attached Ethical Clearance Certificate.

Permission is hereby granted to carry out the research as described in the approved proposal.

Best Regards

A handwritten signature in black ink, appearing to be 'AEE Shikongo', is written over a horizontal line.

Dr. AEE Shikongo
Head: Postgraduate Support Services
Tel: +264 61 206 3129
E-mail: aeshikongo@unam.na



APPENDIX C: LETTER TO THE EXECUTIVE DIRECTOR OF MOEAC

P.O. BOX 897
Cell: +264 813 135 480
Email: pawazanda97@gmail.com
Ohangwena
Date: 14 September 2021

The Executive Director
Ministry of Education, Arts and Culture
Private bag 13186
Windhoek

Dear Mrs Sanet Steenkamp


Subject: Requesting permission to conduct research at secondary schools in Ongha circuit, Ohangwena Region.

I Ferdina Pomwene-Pawa Albinus, am a student at the University of Namibia pursuing a Master in mathematics Education degree (student number: 201309272), as part of my M.Ed. programme. I am to conduct a study titled: Assessing mathematics teachers' level of Information and Communication Technology integration using Substitution Augmentation Modification Redefinition model; a case study of Millennium challenge account schools in Ohangwena region

I am humbly requesting permission from your office to conduct a study at three (3) secondary schools in Ongha circuit. This research is about generating knowledge on the integration of information and communication technology in the teaching of mathematics at secondary schools in Ongha circuit. The finding of this study might provide information that might help the ministry of education arts and culture; when making decisions based on the provision of ICT facilities, teacher training and resource management in schools. Therefore, the findings of this study will be shared with the Ministry of Education, Arts and Culture as a copy of final report will be submitted to your office.

I have attached copies of the ethical clearance from the University of Namibia Research Ethics Committee , a research permission letter from Post Graduate Studies' director and a summary of the proposal of the indented study.

Yours sincerely



Ferdina Pomwene-Pawa Albinus

M.Ed. student (UNAM)

Mathematics Teacher: Engela Secondary School, Ohangwena region.

APPENDIX D: PERMISSION LETTER FROM THE EXECUTIVE DIRECTOR OF MOEAC



REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION, ARTS AND CULTURE

Enquiries: Mr. G. Munene
Tel: +264 61 -293 3202
Fax: +264 61- 293 3922
Email: Gibson.Munene@moe.gov.na
File no: 13/2/9/1

Luther Street, Govt. Office Park
Private Bag 13186
Windhoek
Namibia

Ms Ferdina Pomwene-Pawa Albinus
P. O. Box 897
Ohangwena
Email: pawazanda97 @gmail.com

Dear Ms Albinus,

SUBJECT: PERMISSION TO CONDUCT ACADEMIC RESEARCH IN OHANGWENA REGION

The Ministry wishes to acknowledge receipt of your letter dated 14 September 2021 seeking for permission to conduct academic research in Ohangwena region for your Master's Degree studies which is focusing on: "*Assessing Mathematics Teachers' Level of Information and Communication Technology Integration Using Substitution Augmentation Modification Redefinition Model: A Case Study of Millennium Challenge Account Schools in Ohangwena Region.*"

Permission has been granted to you. However, you have to seek for further clearance from the Ohangwena Regional Director of Education, Arts and Culture to ensure that:

- the school principals are aware of your survey;
- teaching and learning should not be interrupted;
- participation is voluntary;
- you obtain consent from parents of learners under the age of 16 years.

Furthermore, you are kindly requested to share your research findings with the Ministry after completion of the research project. You may contact Mr G. Munene on the above provided contacts at the Directorate: Programmes and Quality Assurance (PQA) for submission of your research findings at the above indicated details.

We wish you the best in conducting your research and the Ministry looks forward to hearing from you upon completion of your studies.

Yours sincerely,

Sanet L. Steenkamp

EXECUTIVE DIRECTOR



All official correspondence must be addressed to the Executive Director

Page 1 of 1

APPENDIX E: LETTER TO THE REGIONAL DIRECTOR OF EDUCATION

P.O. BOX 897
Cell: +264 813 135 480
Email: pawazanda97@gmail.com
Ohangwena
Date: 14 September 2021

The Director of Education
Ohangwena Regional Council
Directorate of Education
Private bag 88005
Eenhana

Dear Mr. Hamatwi

Subject: Requesting permission to conduct research at secondary schools in Ongha circuit, Ohangwena Region.

I Ferdina Pomwene-Pawa Albinus, am a student at the University of Namibia pursuing a Master in mathematics Education degree (student number: 201309272), as part of my M.Ed. programme. I am to conduct a study titled: Assessing mathematics teachers' level of Information and Communication Technology integration using Substitution Augmentation Modification Redefinition model; a case study of Millennium challenge account schools in Ohangwena region

I am humbly requesting permission from your office to conduct a study at three (3) secondary schools in Ongha circuit. This research is about generating knowledge on the integration of information and communication technology in the teaching of mathematics at secondary schools in Ongha circuit. The finding of this study might provide information that might help the ministry of education arts and culture; when making decisions based on the provision of ICT facilities, teacher training and resource management in schools. Therefore, the findings of this study will be shared with the Ministry of Education, Arts and Culture as a copy of final report will be submitted to your office.

I have attached copies of the ethical clearance from the University of Namibia Research Ethics Committee , a research permission letter from Post Graduate Studies' director and a summary of the proposal of the indented study.

Yours sincerely



Ferdina Pomwene-Pawa Albinus

M.Ed. student (UNAM)

Mathematics Teacher: Engela Secondary School, Ohangwena region.

APPENDIX F: PERMISSION LETTER FROM THE REGIONAL DIRECTOR OF EDUCATION



REPUBLIC OF NAMIBIA
OHANGWENA REGIONAL COUNCIL

DIRECTORATE OF EDUCATION, ARTS AND CULTURE

Office of the Director
Tel: (+264) 65 290201
Fax: (+264) 65 290224
Enquiries: Mirjam Nambahu
Email: ndapewa.nambahu@gmail.com
Our Ref: 26/1/9/8

Harelbecke Street, Greenwell Complex Building
Private Bag 88005
EENHANA

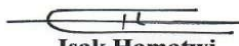
15 September 2021

Ms. Ferdina Pomwene-Pawa Albinus
PO Box 897
Ohangwena
Pawazanda97@gmail.com

SUBJECT: REQUEST FOR PERMISSION TO CONDUCT RESEARCH IN OHANGWENA REGION

1. Receipt of your letter dated 14 September 2021 is hereby acknowledged.
2. The request has been evaluated and found to have merit.
3. Kindly be informed that permission to conduct research in Secondary School in Ongha Circuit has been granted under the following conditions and requests:
 - The data to be collected is only to be used for the completion of your studies.
 - You have to liaise with the Principals concerned to make prior arrangements before the date of the research.
 - No other data should be collected other than the data stated in the request.
 - You may share the final report of your study with the directorate.
4. It is trusted that you will find this arrangement in order. In addition, we wish you all the best with your studies.

Yours Sincerely,


Isak Hamatwi
REGIONAL DIRECTOR



APPENDIX G: LETTER TO SCHOOL PRINCIPALS

P.O. BOX 897
Cell: +264 813 135 480
Email: pawazanda97@gmail.com
Ohangwena
Date: 21 September 2021

The school principal
_____ School
Ongha Circuit
Ohangwena Region

Dear _____

Subject: Research to be conducted at _____ School

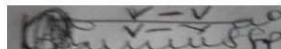
I'm Ferdina Albinus, a Master degree student in mathematics education at the University of Namibia. To qualify for my Master degree, I am requested to write a research report on a topic of interest. My research title is: **Assessing mathematics teachers' level of Information and Communication Technology integration using Substitution Augmentation Modification Redefinition model: A case study of Millennium challenge account schools in Ohangwena region.**

I am therefore, kindly requesting your good office to allow me to carry out my research at your school. Attached please find the proof of permissions to conduct the research from UNAM, executive director of education arts and culture, and from the education director of Ohangwena education Region.

The data will be collected using observations and interviews. Observation will be done during mathematics lessons at secondary grades (8-11/12). A teacher teaching more than one grade will be observed twice, one time in each of any two grades. Lesson presentation will be recorded and some pictures will be taken where necessary. The school lessons time table will be used so to prevent lesson disturbances. Interview will be done after observations at a time suggested by the teacher under the study. A voice recorder will be used to make it easy for the researcher to analyse the data with ease. It should be noted that the whole research process will be used only for the study purposes

Thanking you in advance.

Yours sincerely



Albinus Ferdina

APPENDIX H: CONSENT FORM: TEACHERS

CONSENT LETTER

Assessing mathematics teachers' level of Information and Communication Technology integration using Substitution Augmentation Modification Redefinition model: A case study of Millennium challenge account schools in Ohangwena region.

Researcher: *Ferdina Pomwene – Pawa Albinus*

I have been given information about the study and discussed the research study with Ms Albinus who is conducting this research as part of her M.Ed. (Mathematics Education) degree supervised by Dr Haimbodi N Frans, in the department of Mathematics, Science and Sport Education at the University of Namibia.

I have been advised of the potential risks associated with this research and have had an opportunity to ask Ms Albinus any questions I may have had about the research and my participation. I understand that my participation on this research is voluntary, I am free to refuse to participate and to withdraw from the research at any time and that my refusal to participate or withdraw of consent will not affect my treatment in any way or relationship with the University of Namibia.

If I have any queries about this research, I can contact Ms Albinus at +264 813 135 480 and or Dr Haimbodi at +264 662 686 230 or if I have any concern or complaints regarding the way the research or the way it is conducted, I can also contact the research ethics committee, UNAM at +264 612 063 111.

By signing below, I am indicating my consent to participate in the research. I understand that the data collected from my participation will be used primarily for M.Ed. thesis and I consent for it to be used in that manner.

Signed

Date

Full name: _____ Place: _____

APPENDIX I: OBSERVATION SHEET

Section A: The teacher's level of ICT integration part 1

The ICTs and how they were used during the teaching processes to give notes to learners, assessment of learners and providing feedback to learners.

Class task	What ICT tool was used and how it was used
Giving of Notes to learners	
Giving assessment activities	
Giving Feedback to learners	
ICTs used	
SAMR model level	

Remarks:

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Section B: The teacher's level of ICT integration part 1 (Sample of section A)

APPENDIX I: OBSERVATION SHEET ^B (sample)

The teacher's level of ICT integration

The ICTs and how they were used during the teaching processes to give notes to learners, assessment of learners and providing feedback to learners.

PARTICIPANT TB₂ TOPIC Logarithm LESSON 2 DATE: 28/09/2021

Class task	What ICT tool was used and how it was used
Giving of Notes to learners	A photocopy machine was used. The teacher made enough copies for all learners from the text book.
Giving assessment activities	A Computer and printer and photocopy were used. The teacher typed classwork, print and made enough copies for the learners.
Giving Feedback to learners	* No ICTs was used * The teacher only used a chalkboard
What other tasks observed	- None
SAMR model level	Substitution

Remarks:

The teacher replaces the use of chalkboard with the hard copies made from from textbooks or typed, and printed. ICTs involved were: Computer, Printer and Photocopying machine.

SAMR level: Substitution

[Handwritten signature]

Section C: The teacher's level of ICT integration part (Combination of information/ analysis)

Class task	TA1	TA2	TB1	TB2	TC1	TC2
Giving of Notes to learners						
Giving assessment activities						
Giving Feedback to learners						
ICTs involved						
SAMR model level						

APPENDIX J: INTERVIEW GUIDE

Section A: Interview guide for teachers at MCA schools.

This interview aims to find out about how you integrate ICT when teaching mathematics. This is not a test or any means of interrogating you. There is no correct or incorrect answer to the question I will ask you. Your responses in this interview will never be linked to your name as the principle of confidentiality and anonymity will be strictly adhered to. The information will be used for the purpose of this study.

Demographic information of the participants

Gender: _____ Name of the school: A B C
Grades taught: _____ ICT literate
level _____
Rank: _____ Field of specialization: _____

Interview Items

1. how do you understand the concept of ICT integration in the teaching and learning processes?
2. MCA provided this school with the ICTs. Which ICTs do you use, and how do you use them when giving notes, assessment activities and feedback that is content related to learners?
3. What are the hindrances to the use of ICT equipment do you encounter in your mathematics lessons?
 - a) MCA provided ICTs and training to teachers what did you learn about in this training?
4. What do you think should be done in order to overcome the hindrances you named earlier?

Thank you

Section B: The teacher's level of ICT integration part 2 (interview checklist)

Item number	What the teacher does with ICT	Tick appropriate box	SAMR model Level
1	The teacher types my work instead of handwriting it		
2	Teacher uses a technological tool that makes an abstract concept visible in a hands-on, responsive way (e.g. voyaging on Google Earth to better understand measurement and geography).		
3	The teacher gives more informative and engaging oral presentations accompanied by a PowerPoint containing multimedia elements.		
4	The teacher records learners as they deliver a presentation or practice a physical skill, then using this recording to prompt learners' reflection		
5	The teacher uses the internet to research a topic, and videos to use during lessons.		

6	Teacher produces podcasts summarizing a topic, which can then be accessed by learners and other teachers as a revision resource.		
7	The teacher does experiments with tasks that use extensive multimodal elements (e.g. producing documentaries or short films, webpages, print documents with creative layouts).		
8	The teacher uploading a worksheet in PDF for student access, as opposed to photocopying		
9	The teacher uses an education program that gamifies curriculum content for student engagement and allows students to track progress in an accessible way.		
10	A teacher creates an informative video presentation in place of a standard oral presentation. She/he can use their voice alongside a broader variety of creative multimodal components.		

11	connecting your students with other people around the world as part of the learning journey		
12	The teacher uses a digital interactive whiteboard as opposed to a traditional whiteboard and saving the results as a document.		
13	The teacher let learners publish their work online where it can be viewed by peers and the broader community		
14	The teacher uses online quizzes and programs instead of pen and paper		
15	Teacher instruction is supplemented with a video that clarifies a particular hard to explain contents		