BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

BACHELOR OF SCIENCE EDUCATION HONOURS DEGREE IN MATHEMATICS

ENHANCING MATHEMATICAL PROBLEM SOLVING AMONG FORM FOUR LEARNERS USING INFORMATION TECHNOLOGY

BY

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REG NO.: B225528B

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONOURS DEGREE IN MATHEMATICS EDUCATION

JUNE 2024

SUPERVISOR: MRS T MUKABETA

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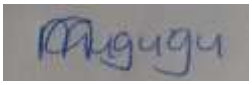

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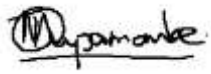

16 JULY 2024

(Signature of Supervisor) (Date)

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APPROVAL FORM

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Degree Title: Bachelor of Science Honours Degree in Mathematics Education

Year of Completion: 2024

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ACKNOWLEDGEMENTS

I acknowledge the support and guidance I received from my supervisor Mrs. T. Mukabeta for her guidance and support.

DEDICATION

I dedicate this research work to my supportive husband and family.

ABBREVIATIONS AND ACRONYMS

CDTS:	Curriculum Development Technical Services
DSI:	District Schools Inspector
HSA:	Head of School A
HSB:	Head of School B
HSC:	Head of School C
ICT:	Information Communication Technology
IT:	Information Technology
IWB:	Interactive White Board
MOPSE:	Ministry of Primary and Secondary Education
NASH:	National Association of Secondary Heads
T1SA:	Teacher 1 of School A
T2SA:	Teacher 2 of School A
T3SA:	Teacher 3 of School A
T1SB:	Teacher 1 of School B
T2SB:	Teacher 2 of School B
T3SB:	Teacher 3 of School B
T1SC:	Teacher 1 of School C
T2SC:	Teacher 2 of School C
T3SC:	Teacher 3 of School C
UNESCO:	United Nations Education and Scientific Cultural Organization

ABSTRACT

The study focused on exploring the enhancing Mathematical problem-solving among Form Four learners using Information Technology. Its objectives were to identify existing IT tools resources used in mathematics education for form four learners; to assess the impact of IT on students' problem-solving skills through empirical studies and to develop guidelines and recommendations for integrating IT effectively into mathematics teaching. The study adopted a constructivist paradigm, qualitative approach and case study research design which used semi-structured and focus group interview guides as research instruments. From the study it emerged that the existing IT tools resources used in mathematics education for form four learners were calculators, interactive white boards, laptops, desktops, WIFI and internet resources and smartphones. In addition, on the impact of IT on students' problem-solving skills through empirical studies it emerged that IT tools resulted in increased confidence and motivation, improved speed in task completion, increased access to diverse resources and limited skills due to limited IT tools. Finally, on guidelines and recommendations for effective ICT integration into Mathematics teaching it emerged that teacher and leadership training, ICT policy, multi-sector approach, adequate resource provision and integrated curriculum development were the guidelines and recommendations for effective ICT integration into Mathematics teaching. Thus, the study concluded that there were limited IT tools used in mathematics teaching in schools and learners were yet to fully understand how to use different ICT tools; IT motivated and empowered learners in problem solving and gave the learners confidence to showcase their learned skills and ICT policy, multi-sector approach and provision of resources were fundamental in integrating IT into mathematics teaching. Therefore, the study recommended that school leadership needs to be trained, developed and prepared for the use and implementation of ICT tools not only in mathematics but across the curriculum's different learning areas; there is need to enhance the utilization of ICT tools in the teaching and learning of mathematics considering that ICT has been noted to be influential and highly motivational and the MOPSE need to engage different stakeholders to develop a robust IT based mathematics curriculum that require the use of IT tools in teaching and learning, formative and summative assessment.

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CHAPTER 1

INTRODUCTION

In today's digital age, Information and Communication Technology (ICT) has become an integral part of education. It offers vast opportunities to enhance mathematical problem-solving skills for learners. By leveraging ICT tools and resources, educators can create engaging and interactive learning experiences that promote critical thinking, analytical reasoning, and mathematical proficiency. In this chapter the researcher gave an overview of the background to the study which covered the Integration of Information and Communication Technologies (ICT) when it came to the enhancement of mathematical problem- solving to form four learners and how it related to the research problem under study. The researcher looked at the statement of the problem, research objectives and research questions. Research questions were important in guiding the study they gave clear focus and purpose to what exactly the researcher wanted to find out. This chapter also focused on the significance of the study which looked at the worthiness of the study, the delimitations which were the choices made by the researcher which should be mentioned. They described the boundaries that the researcher set for the study and the limitations of the study. An overview of the whole research was given this chapter.

1.1 Background to the Study

This research dealt with an exploration of the integration of Information and Communication Technologies enhancing problem solving in the teaching and learning of Mathematics at three selected secondary schools in Sanyati District. The teaching and learning of Mathematics in our society today requires modern technologies and, hence, the need for the integration of

Information and Communication Technologies. Information and Communication Technologies have rapidly become one of the most important aspects of teaching and learning of Mathematics, but also every other subject within the curriculum Rei (2018). Sivakova et al., (2017) say that the ongoing technological changes involve new methods of capturing, processing, storing and displaying information and are capable of increasing productivity and competitiveness through information provision. The role of Information and Communication Technologies in teaching and learning in schools has become huge, hence the importance of Information and Communication Technology integration. Information and Communication Technologies have become more and more important in our day to day lives and in the education system and, therefore, there is an ever-increasing demand on schools to use Information and Communication Technologies in the teaching and learning of Mathematics so that learners acquire skills needed for the twenty first century (Whitten, 2018). The integration of Information and Communication Technologies into all aspects of the society is creating a digitally enabled economy that is responsible for generating economic growth and prosperity (Namitta,2017). Integrating Information and Communication Technologies in the teaching and learning of Mathematics would help learners achieve effective integration of technologies in the existing environment and to promote a better understanding of the subject matter. Several reasons have been put forward as to why Information and Communication Technology based instruction is ideal in the problem solving of Mathematics. Information Communication Technologies make access to educational information easier and reduces barriers of time and place (Kahlon, 2016). Musembi et al (2017) posits that based technologies, for example, can promote the effectiveness of teaching and learning by bringing learners into contact with learning peers form around the world.

1.2 Statement of the Problem

Mathematical problem solving is a critical skill that students need to develop in order to excel in mathematics and apply their knowledge to real world situations. However, many students struggle with this skill, finding it challenging to connect mathematical concepts with problem solving strategies, the effective integration of Information and Communication Technology (ICT) in mathematics education. While ICT offers a range of tools, resources, and activities that have the potential to support problem-solving the problem addressed in this study is the need to enhance students' mathematical problem-solving skills, there is a lack of comprehensive research on its effectiveness and best practices in this context. This research is going to study the use of Information and Communication Technologies (ICTs) to enhance Mathematical problem solving at three selected secondary schools.

1.3 Research Objectives

Research objectives were

1 To identify existing IT tools resources used in mathematics education for form four learners.

2 To assess the impact of IT on students' problem-solving skills through empirical studies.

3 To develop guidelines and recommendations for integrating IT effectively into mathematics teaching.

1.4 RESEARCH AIM

The aim of this study is to investigate how the integration of Information Technology (IT) can enhance mathematical problem -solving skills among form four learners.

1.5 Research Questions

1. What is the current practices challenges related to using IT in Mathematics education for form four learners?

2. How does the use of IT impact students' mathematical problem -solving abilities?

3. What strategies can be employed to effectively integrate IT into mathematics instruction for form four learners?

1.6 Significance of the Study

This study would assist mathematics teachers and learners in making decisions on how to adopt and integrate Information and Communication Technologies in the teaching and learning process. Teachers would benefit from this study because their work would be made much easier considering that the use of Information and Communication Technologies in the teaching and learning of Mathematics is learner-centered. There would be a marked improvement in pass rates since Information and Communication Technologies provide a wide range of teaching and learning materials, some of which are recent. To the learners, the research would be of paramount importance because they would be equipped with basic Information and Communication Technologies which are very important in their later lives. Information and Communication Technologies make learning possible even in the physical absence of the teacher. Collaborative learning would become an important part of knowledge dissemination and, hence, making the teaching and learning process very interesting. To the nation as a whole, the integration of Information and Communication Technologies would improve the economy since modern day economic development is hinged on Information and Communication Technologies.

1.7 Delimitations of the Study

Duration of the Study: The duration of the study may impact the extent to which the effects of ICT integration on problem-solving skills can be observed. The availability of ICT resources, such as computers, software, and internet connectivity, may vary across different educational settings. Resource constraints can limit the implementation of ICT interventions and the extent to which students can engage with the technology, potentially influencing the outcomes of the study. The effectiveness of ICT integration may be influenced by the skills, experience, and teaching approaches of individual educators. Variations in teacher expertise and instructional practices may affect the outcomes, making it challenging to isolate the impact of ICT alone. Assessing problem-solving skills can be complex, and different measurement tools or methods may yield varying results. The study should carefully select or develop appropriate assessment instruments to accurately measure problem-solving abilities and consider potential limitations or biases associated with these measures. Student characteristics, such as prior knowledge, motivation, and attitudes towards mathematics and technology, can influence the outcomes of the study. These factors should be considered and potentially controlled for study to be successful.

1.8 Limitations of the Study

The duration of the study may impact the extent to which the effects of ICT integration on problem-solving skills can be observed. A short-term study is going to be taken into consideration for conducting this research. The availability of ICT resources, such as computers, software, and internet connectivity, may vary across different educational settings. Resource constraints can limit the implementation of ICT interventions and the extent to which students can engage with the technology, potentially influencing the outcomes of the of the study. Measurement of Problem-

Solving Skills: Assessing problem-solving skills can be complex, and different measurement tools or methods may yield varying results. The study should carefully select or develop appropriate assessment instruments to accurately measure problem-solving abilities and consider potential limitations or biases associated with these measures. Student characteristics, such as prior knowledge, motivation, and attitudes towards mathematics and technology, can influence the outcomes of the study.

1.9 DEFINITION OF TERMS

1. Information and Communication Technology (ICT): ICT refers to the technologies and tools used to create, store, transmit, and retrieve information. In the context of education, ICT encompasses digital devices, software applications, internet connectivity, and other technologies that are used for teaching, learning, and communication purposes.

2. Mathematical Problem-Solving Skills: Mathematical problem-solving skills refer to the ability to apply mathematical knowledge and strategies to solve complex problems. It involves identifying problems, formulating appropriate strategies, analyzing information, making connections, and reaching valid solutions using mathematical reasoning and critical thinking.

3. Integration of ICT: Integration of ICT in education refers to the intentional and systematic use of technology tools, resources, and platforms to enhance teaching, learning, and assessment processes. It involves incorporating ICT into instructional practices, curriculum design, and assessment methods to support and enhance the learning outcomes.

4. Abstract Mathematical Concepts: Abstract mathematical concepts are mathematical ideas or principles that are not directly tied to concrete objects or real-world situations. They often involve

symbols, formulas, and mathematical notation and require students to think conceptually and symbolically to understand and apply them.

5. Real-World Problem-Solving Applications: Real-world problem-solving applications involve applying mathematical concepts and skills to authentic, everyday situations or practical problems outside the mathematics classroom. It requires students to transfer their mathematical knowledge to real-life contexts, making connections between abstract concepts and their real-world applications.

6. Collaborative Problem-Solving: Collaborative problem-solving refers to the process of working together in a group or team to solve problems. It involves sharing ideas, insights, and strategies, engaging in discussion and negotiation, and collectively reaching solutions. Collaborative problem-solving can be facilitated using ICT platforms and tools that enable communication, collaboration, and information sharing among team

7 Problem-Solving Strategies: Problem-solving strategies are systematic approaches or techniques used to tackle mathematical problems. They involve breaking down complex problems into smaller, manageable parts, applying logical reasoning, using appropriate mathematical tools and methods, and analyzing and evaluating the solutions. Problem-solving strategies can be taught and practiced to enhance students' problem-solving skills.

1.10 SUMMARY

The researcher highlighted the background of the study, the statement of the problem, the research questions and sub-questions, the aims and objectives, the significance of the study. The limitations and delimitations of the study and the definitions of key terms were discussed as well.

CHAPTER 2

REVIEW OF THE RELATED LITERATURE

2.1 Introduction

In the study on how to enhance mathematical problem-solving using IT to form four learners the researcher will present and analyze literature from different researchers from the globe, regionally and from Zimbabwe. Information and communication technology (ICT) is a powerful tool to enhance learning experience across various subjects, including Mathematics. Mathematics is a subject that crucial for students in all levels of education, as it has a developing critical thinking and problem-solving skills. By integrating IT in teaching and learning of Mathematics, students can be encouraged to actively engage in problem solving activities to develop a better understanding of Mathematical concepts. This literature review aims to examine the use of IT to enhance mathematical problem-solving skills among form four learners. Literature will be reviewed based on the research objectives under the sub-headings: ICT tools used in Mathematics education; Impact of ICT on students' problem-solving skills; Guidelines and recommendations for effective integration into Mathematics teaching.

2.2 ICT tools used in Mathematics education

There are a variety of ICT tools utilized in Mathematics education and these ICT tools include television, internet, computers, tablets, laptops, graphic calculators, electronic notice boards; mobile devices; interactive boards; software tools like GeoGebra, Logo, Computer Algebra Software (CAS), Dynamic Geometry Systems (DGS), spreadsheets (Voogt, 2010; Sheila, 2016; Das, 2019; Musa & Garbo, 2019; Ata-Baah, 2020; Starja, Shity & Nikolova; 2020; Sawyerr, 2021;

Nteziryimama & Niyobuhungiro, 2023; Niyibizi & Mutarutinya, 2024). Some of the ICT tools are discussed hereunder;

2.2.1 Calculators and Graphic calculators

Clements (2000) cited in Voogt (2010) report that the utilization of graphic calculators and computerized graphing in mathematics accelerates the graphing process giving learners more free time to analyze and reflect relationships that exist between data. In addition, calculators enable students produce many examples when exploring mathematical problems and this supports the observation of relationships and the making and justifying of generalizations (Panne, 2015). Besides that, Musa and Garba (2019); Sheila (2016) found that calculators and graphic calculators accelerate the rate at which learners solved mathematical problems which results in enhanced accurate results and bolstered learners' confidence in Mathematics. Lucas and Cady (2012) cited in Sheila (2016) assert that educators can make use of calculators to give activities that assist learners to develop their mathematical understanding about different concepts. Furthermore, calculators enhance learners' confidence in the accuracy of their graphs enabling them to operate autonomously from the teacher (Bowker et al., 2009 cited in Sawyerr, 2021). Finally, Sawyerr (2021), reports that, utilization of graphic calculators has an effect on the transition from arithmetic to algebra. It is evident that calculators and graphic calculators are empowering to the learners in terms of confidence building, ability to work independently, having better thinking and problem - solving strategies.

2.2.2 Mobile devices (Mobile Learning)

Mobile learning has become popular as it provides learning activities on the go both synchronous and asynchronous. Hoofman (2006) cited in Nicolete, Blessimo, Cristiano, da Silva, Simalo and da Silva (2017) assert that mobile learning involves the use of mobile technology in education to produce and educational experience anywhere and anytime. In this case, Calkins (2009) cited in Sheila (2014) contends that mobile phones can be used as a teacher, supplying software applications to learners in an effort to generate high quality studying habits on the go. In addition, Calkins (2009) cited in Sawyerr (2021) further reports that smart phones are used as effective educational environment tools facilitating more efficient knowledge collection and study, thus leading to an enhanced meaningful and enlightened experience.

However, research from Canada describes challenges for mobile learning which include small screen and keyboard, facilitators not knowing how to design and develop mobile instructional learning materials, negative facilitator perceptions of mobile learning, no standard for mobile instructional material and not enough mobile learning teaching materials (Sheila, 2016). Nevertheless, in spite of the challenges inherent with mobile devices, Nicolete et al., (2017) contend that in places where the shortage of technological resources prevents teachers to innovate in their teaching methodologies, mobile phones provide novel exciting ways to improve education enabling digital inclusion in the poorest and remote places. Thus, UNESCO (2014) cited in Nicolete et al., (2017) confirms that mobile technology is the most pervasive technology and quickly adapted and is very common even in areas where learning institutions, books and computers are rare.

2.2.3 Mathematics software

There is a variety of software that used in mathematics. First, Amado and Carreira (2012) cited in Sawyerr (2021) found that spreadsheet is a potent tool for solving mathematical problems and especially for developing algebraic thinking embedded in the activities of problem solving. Musa and Garbbba (2019) note databases and spreadsheets provide learners with the confidence of analyzing large amount of data. Not only that, Nobre, Amado and Carreira (2012) cited in Sheila (2016) reiterate that spreadsheet is a potent instrument in Mathematical problem solving and especially in the construction of algebraic thinking embedded in problem solving activities. The authors further found that a significant environment is created to induce learners into algebraic language that facilitates the construction of algebra concepts through the linking of algebraic thinking and the utilization of spreadsheets.

Second, GeoGebra according to Das (2019) are robust software that assists learners learn mathematics effectively and solve mathematics problems on diverse topics. In addition, Venkatarama (2012) cited in Ata-Baah (2020) found that GeoGebra has the capability to build inventive activities and geometrical thinking which makes it a profound choice by the majority of practitioners. Pannen (2015) says with the availability of the mathematics software the teaching and learning of mathematics can be designed differently and creatively, allowing both students and teachers to take advantage of the ICT enabled learning. Furthermore, Geometric software and algebraic systems provide learners a bridge form the abstract world of mathematics to the concrete world where learners are able to create and observe numerical representations. Ata-Baah (2020) notes that, GeoGebra provides extensive dynamic geometry concepts in mathematical analysis and its utilization has the capability of bringing meaning to abstract concepts through visualization.

Finally, Musa and Garba (2019) found out that report that integrated mathematical packages allow learners the opportunity to explore problem based learning and mathematical games and simulations help learners to apply mathematical ideas to problem situations. It is evident that the use of ICT packages in mathematics education enhances the efficiency of the teaching process as well as the learners' understanding of fundamental concepts (Essuman et al., 2022 cited in Niyibizi & Mutarutinya, 2024). In addition, Clements (2000) cited in Atah-Baah (2020) contends that logo encourages learners to develop problem solving skills, leads them to develop higher levels of mathematical thinking as well as learn geometric concepts. Therefore, Musa and Garba (2019) found that geometric software and algebraic systems avails to learners a springboard from the abstract world of Mathematics to the concrete world wherein learners are capable of creating and observing numerical representations

2.2.4 Computers and Internet

Both teachers and learners can use the internet to gather information, knowledge, concepts and data access resources for downloading, interact directly with interactive content and communicate mathematically with others (Sue & Primm, 2004 cited in Niyibizi & Mutarutinya, 2024). Computers and internet have been considered an important method for studying Mathematics in the 21st century and Sheila (2016) notes that to function as a tool the computer is used as a tool for teaching and learning. In this case, Varghese (2012) cited in Sheila (2016) concludes that computers can change the logical mathematical thought of a computer programmer to interesting interactive video games. In addition, Pannen (2015) posits that computers enables students to work with real data which can be represented in a variety of ways and this supports interpretation and analysis that leads learners to higher order thinking skills. Furthermore, in a study by Ku et al.,

(2014) cited in Ashiono, Mwama and Murungi (2015) it emerged that digital game -based learning significantly enhanced children's level of confidence in Mathematics.

2.2.5 Interactive whiteboards

From a study by Starja et al., (2020) it emerged that the use of interactive whiteboards (IWB) is one of the technological innovations that are being widely introduced in private schools in Albania and less in public schools in teaching in general and in teaching Mathematics in particular. The IWB brings unforgettable learning experiences enriched with visual elements and serve as a connecting bridge to integrating technology into mathematical technology. In this case, Qizi and Wuydinjonova (2020) emphasize that technology is an essential tool for learning mathematics in the 21st century and all educational institutions must ensure that all their students have access to technology. As a result, the authors reveal that research has found that when technology makes abstract ideas tangible, teachers can build easy prior knowledge and skills upon learners.

2.3 Impact of ICT on students' problem- solving skills

First, ICT enable the incorporation of multi-sensory elements for learners with dyslexia (Demetriou, 2010). In this case, ICT can be noted to have the power to ensure that not only cognitive skills are developed but also affective and psychomotor skills as learners work to enhance their skills in mathematics through the use of different ICT tools. Voogt (2010); Dhakal (2018); Vanderlinele, Aesaert and Van-Braak (2014) cited in Sawyeer (2021) note that, ICT tools promote constructivist pedagogy wherein learners use technology to explore and reach an understanding of mathematical concepts. This approach is noted to promote higher order thinking and enhanced problem solving. Pastor and Pedro (2023) found that the integration of ICT plays a significant role in enhancing problem solving skills and Leite (2019) cited in Pastor and Pedro

(2023) contend that research has shown that ICT can assist learners in developing higher order mathematical thinking and problem solving.

Second, Ata-Baah (2020) contends that the theory of Multiple Intelligences by Gardner suggests that learning takes place in variety ways when using ICT (Gardner, 1993). In addition, Sheila (2016) adds, ICT provides many opportunities and possibilities for disabled learners to improve their mathematical abilities. It is evident that ICT tools have diverse influence in mathematics and broaden and sharpen learners' skills and competences in mathematics. Microsoft (2014) cited in Pannen (2015) elaborates that ICT in teaching and learning has potential at developing self-regulation, collaboration, knowledge construction, real world problem solving and innovation and skilled communication. The 21st century has become marred with diverse problems which demand heightened skills in problem solving. . Ciroma (2014) cited in Netsianda and Ramaila (2021) report that the utilization of ICT in education supports the development of 21st century skills, collaboration, problem solving, decision making, critical thinking, creativity and innovation.

Third, ICT helps to increase the critical thinking skills, analyzing skills (Fitzallen, 2005 cited in Joshi, 2017) understanding and application skills of students (Wilson et al., 2005 cited in Joshi, 2017). In addition, ICT provides learners with advanced communication tools what allow them to use graphics, images, sound and text in their course of learning (Ashiono, Mwoma and Murungi, 2015). Moreover, CTLI (2007) cited in Josh (2017) adds that ICT tools develop abstract ideas for teachers by which they can build learners' prior knowledge, abilities and skills, links to the materials with mathematical concepts, address common understanding and introduce more advanced ideas. This entails that ICT enhance learners' problem- solving skills as through ICT

tools use according to Das (2019) learners spend productive time developing strategies for solving complex problems and develop a deep understanding of the diverse mathematics topics.

Fourth, Khomo (2018) found that ICT tools can contribute to effective interactive methods of teaching and learning mathematics which promote creative thinking and participation in the education process. Creative thinking leads to better problem -solving skills. In a study by Musa and Garba (2019) it was concluded that the use of ICT in teaching and learning mathematics can make the teaching process more efficient and enhance learners' capabilities in understanding basic concepts. In addition, Gachinu (2014) notes the use of ICT in learning mathematics motivate learners in learning, particularly in cases where activities were challenging, multi-disciplinary and multi-sectorial. Consequently, ICT based learning could change the belief that mathematics was challenging since ICT could open an opportunity where learners and teachers may access a variety of information relevant to solving specific learning difficulties, exposure to more tests and a varied types of questions which the teacher could not be able to give to the learners in class.

Finally, ICT motivates learners learning, support their independent learning and active participation in discovery of mathematics concepts and topics that help them have deeper understanding of mathematical ideas (Baya'a & Daher, 2013 cited in Niem, Verina & Alcantaro, 2020). In addition, Armah and Apeanti (2012) cited in Sawyerr (2021) found that ICT encourages constructivist pedagogy in which learners utilize ICT to investigate and understand mathematical ideas by enabling them to focus on response methods and interpretations instead of wasting time on repetitive numerical calculations. In this regard, ICT is empowering to facilitators and learners, turn the instructional process from highly teacher centred to student centred and the change can

lead to improved learning gains for students. Thus, learners' imagination, problem solving behaviours, knowledge reasoning skills and communication skills are created and empowered.

2.4 Guidelines and recommendations for effective ICT integration into Mathematics teaching

Considering the immense benefits noted above that come with utilizing ICT tools in the teaching and learning of mathematics it is imperative that ICT is effectively integrated into Mathematics teaching. Starja et al., (2020) assert that the implementation of technology in teaching has now become a trend of the modern world and Lavicza (2008) cited in Josh (2017) argues that while the quality of mathematics software has been improving rapidly technology is still marginally integrated into education at all levels. In addition, Nteziryimama and Niyobuhungiro (2023) report that ICT integration in the teaching of mathematics is expected to promote understanding of abstract concepts and enhancing learners' motivation while reaching diversity in learning styles.

First, Pannen (2015) suggests that to be able to integrate ICT in teaching and learning, to use ICT effectively and creatively, teachers are expected to believe in the effectiveness of ICT has been proven by several studies. It is through belief that one can have enhanced locus of control. In addition, a study by Sheila (2015) recommended that students should be allowed to use smartphones for learning purposes only and teachers be trained on how to integrate ICT in teaching and learning of mathematics during pre-service course and in-service practice. Sandik, (2008) cited in Sheila (2015) advises that meaningful integration can only be achieved in mathematics education when learners are able to select technology tools to assist them acquire information and present it professionally.

Secondly, from a study by Chinaka (2017) it emerged that lack of infrastructure, unavailability of electricity, teachers' lack of ICT knowledge and skills and lack of funding have emerged as the key factors that are hindering the successful adoption and integration of ICTs in rural schools. Based on these findings it can be recommended that addressing these challenges will help in ensuring effective integration of ICT in the teaching of mathematics. Buabeng-Andoh (2012) cited in Amuko, Miheso and Ndeuthi (2015) contends that positive attitudes towards computer use by school teachers are significant to ensure the integration of the technology is effectively carried out in the school curriculum and also during teaching and learning. In addition, training enables teachers to acquire knowledge and skills on how to use mathematics software effectively (Amuko et al., 2015) and from a study by Chesitt (2015) it was recommended that technology skills should be integrated into the total curriculum during the entire education process through holistic approach and that ICT should be exploited to support the complete mathematics content and learning experience. Besides, teachers of mathematics need frequent in-service courses on the new innovations in terms of instructional skills and approaches.

Third, a study conducted by Cubukcougln (2013) cited in Chesitt (2015) found that in order to create an environment where technology is used frequently and effectively, it is vital to support the need of teachers in using technology in teaching and learning. In this case, teacher training programs should be based on the use of ICT for all subjects and education policy and curricula should be revised periodically to meet the demand of the present situation (Das, 2019). In addition, Dhaka (2018) found that for successful integration of ICT into mathematics curriculum it is essential to have knowledge of the existing software that is used by mathematics teachers. Knowledge of software is important as it gives teachers and school leaders alternatives to choose from based on their needs concerning the software to use in the teaching and learning of

mathematics. In this case, teacher computer competence is a major predictor of integrating ICT in teaching. Agyer and Voogt (2012) as cited in Sheila (2016) conducted a study in Ghana among learners and practicing mathematics teachers and reported low level of technology integration due to low competences and access of technology. Consequently, Dhakal (2018) from his study concluded that lack of knowledge to integrate ICT tools, availability of resources, affordability by learners and insufficient teacher training provisions stifled meaningful ICT integration in teaching and learning. Therefore, Muhtadi, Wayhudn, Kartasasmita and Prahmonc (2017) reported that a teacher with the knowledge TPACK is assumed to be able to figure out how to integrate technology into specific content and can apply the pedagogy most appropriate. Therefore, Jang and Tsai (2012) cited in Muhtadi et al., (2017) emphasize that teachers in the 21st century are expected to be able to discover how to integrate technology into every aspect of education such as curriculum design, implementation, management and education.

Finally, besides knowing the existing software, from a study by Bektos et al., (2012) cited in Sheila (2016) it was recommended that there is need for mathematics educators and curriculum developers to integrate educational software and textbooks. However, UNESCO (2007) cited in Sheila (2016) argues that one of the major problems is that the educational software is often isolated and not integrated with the textbooks that may facilitate use. The absence of such an essential link means that the use of software in mathematics and the use of textbooks remains disjointed, uncoordinated and optional resulting in a haphazard use of educational software in mathematics education.

2.5 Research gaps

Based on the reviewed literature it is evident that there is still a gap in the enhancement of Mathematical problem solving among learners using information technology considering that teachers are still not qualified to utilize ICT in the teaching of Mathematics (Das, 2019), schools still lack adequate ICT infrastructure (Wen & Maat, 2020), Mathematics software is varied and the software is not yet to be fully integrated with mathematics textbooks (Sheila, 2016). These existing gaps provide reason and justification for the researcher to undertake a study on the enhancing of Mathematics problem solving among learners using information technology.

2.6 Chapter Summary

The chapter dwelt on review of related literature where literature was reviewed based on the research objectives that guided the study. The research objectives aimed to identify existing IT tools resources used in mathematics education for form four learners; to assess the impact of IT on students' problem-solving skills through empirical studies; and to develop guidelines and recommendations for integrating IT effectively into mathematics teaching. The research gap was identified based on the empirical studies reviewed in literature review. The next chapter focused on research methodology for the study.

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

The study focused on enhancing Mathematical problem solving among form four learners using information technology. In this chapter the research methodology for the study is elaborated starting with the research design.

3.2 Research design

Research design is hereby presented under the sub-headings research paradigm, its ontology, epistemology and axiology. The research paradigm adopted was constructivist in nature.

3.2.1 Research Paradigm

Paradigm according to Hadi and Closs (2016) is a discrete set of beliefs. This study adopted a constructivist paradigm, qualitative approach, case study research design and thematic analysis of data based on what and how research questions that guided this study.

Constructivism

this study was located in the constructivist paradigm and Neuman (2011) cited in Chinooneka (2020) defines the constructivist paradigm as the systematic analysis of socially meaningful action through the detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people create and maintain their social works. the objective of constructivism as a paradigm is to generate a pattern of meanings from the views of participants. In this study, the research intended to explore enhancing mathematical problem solving among

form four learners using information technology. In this case, considering the diversity in school set-ups, teachers' perceptions, views, beliefs, opinions and experiences in the use of ICT in mathematical teaching and learning the researcher felt the need to use the constructivist paradigm to ensure that the research problem can be understood contextually.

Ontology

Denzin & Lincoln (2018) cited in Jakachira (2020) view ontology as a philosophical belief system that is concerned about the nature of social reality. The study chose constructivism based on the view that ontologically it refutes the existence of a single reality and aims at establishing the truths that are built by the participants (Lichtman, 2009 cited in Guvhu, 2018). The ontological stance of the research accepts the personal and subjective nature. Thus, Ford (2012) cited in Okesina (2020) notes that subjective ontology holds the view that research problems have multiple realities that can be explored and meanings to be derived by the researcher based on their relating with the study participants. Therefore, the main task of the researcher was to construct meaning based on the context of different schools in terms of the research problem which sought to explore enhancing mathematical problem solving among form four learners using information technology. In this case, different schools and their respective participants would give diverse meanings attached to identifying existing IT tools and resources used in mathematics education for form four learners, assessing the impact of IT on students' problem-solving skills through empirical studies and developing guidelines and recommendations for integrating IT effectively into mathematics teaching. The basic ontological question of this study was; How were schools enhancing mathematical problem solving among form four learners using information technology.

Epistemology

Nguyen (2019) cited in Okesina (2020) views epistemology as how we come to know something, how we know the truth of reality. Epistemology is viewed as the philosophical belief system concerning how we come to know about the world around us and what counts as the true knowledge. From an epistemological perspective the research focused on establishing meaning within the natural context that is, finding out how ICT was impacting students' problem-solving skills in mathematics.

Axiology

According to Hanafizadeh and Shafia (2021) axiology probes how valid knowledge can be acquired and, in this study, valid knowledge was acquired through interviews with participants who were involved in the area of study.

3.2.2 Research Methodology

Drawing from the constructivist paradigm the study utilized the qualitative research approach. Creswell (2014) cited in Chinooneka (2020) defines a research approach as strategies and methods for research that extend the decisions from general assumptions to thorough methods of data gathering and reasoning. Carlsgon et al (2017) cited in Hakami (2022) views qualitative research approach as an approach that allows individual experience to become clearly evident and assists in providing a diversity of these experiences. In the process of providing these experiences Mamba (2019) cited in Hakami (2022) reveals that qualitative research approach aims to answer questions about why; how and what of a phenomenon and this approach is appropriate if the researcher desires to understand the perspectives of the research participants and pursue the meaning they

give to phenomena. The main aim of this approach was to get an in-depth description and understanding of actions and events. This study embraced the qualitative research approach which draws from the constructivist paradigm. Creswell and Creswell (2018) cited in Jakachira (2020) define qualitative research approach as a form of inductive research that focuses on understanding the subjective meaning that individuals or groups attach to a social situation in its natural settings. The aim of the qualitative approach was to generate an insider's view of social reality in natural settings as far as the enhancing of mathematical problem solving among form four learners using information technology was concerned. The research methodology was qualitative in nature and this methodology seeks to study a research problem in its natural settings. Therefore, the study sought to study the research problem in school set-ups.

3.2.3 Research Strategy

Saxena et al., (2013) cited in Hanafizadeh and Shafia (2021) view a research strategy as a focal point guided by the researcher's ideology. The study adopted an exploratory strategy which is generally qualitative according to Casula et al., (2020) cited in Hanafizadeh and Shafia (2021).

3.3 Research Methods

Research methods are the techniques and approaches that one uses in the implementation of research (Kapur, 2018). In this study, interviews were used to generate data for the study. Goundar (2012) asserts that research methods help us to collect samples, data and find a solution to a problem. In this regard, it was through interviews that data was generated by the researcher which was later transcribed and analyzed to reach conclusions based on the generated data. Consequently, the recommendations reached by the study were as a result of the methods used. Therefore, research methods aim at finding solutions to research problems.

3.3.1 Population and sampling

Population

Jakachira (2020) refers to population as the entire set of individuals or other entities to which the findings of the study are transferred. The population for the study comprised of thirty-six secondary schools which make up five NASH clusters in Sanyati District. From these clusters one cluster, Chakari Cluster, was purposively selected to participate in the study and the cluster had five secondary schools. The cluster and its secondary schools were purposively selected by virtue of being close to the researcher's place of work as this would minimise costs involved in undertaking the study and it is from these secondary schools that the sample for the study was selected.

Sampling

Sampling according to James and Simister (2017) is a process that enables information to be collected from a small number of individuals or organizations within a project and then utilized to draw conclusion about a wider population. In this study, purposive sampling was used in coming up with the sample for the study from the population of three schools, three school heads and eighteen mathematics teachers that make-up cluster. From the three heads all the heads were purposively selected to participate in the study and from the eighteen Mathematics teachers, nine mathematics teachers were selected, three teachers per school, to participate in the study. Therefore, the study had a sample of twelve participants, four from each school. Purposive sampling was used to select one school head and three Mathematics teachers in the school. James and Simister (2017) define purposive sampling as a process of selecting sample on the basis of knowledge of the research problem to allow selection of appropriate persons for inclusion in the

sample. The school head was selected because of being a leader in the school and leaders by virtue of being at the helm of a school influence significantly the teaching and learning and provision of resources in the school. The mathematics teachers were chosen because they were the ones in charge of enhancing mathematics problem solving among form four learners using information technology. Those Mathematics teachers who were not teaching form four learners were not part of the sample.

3.3.2 Research Instruments

Sathiyaseelan (2020) defines research instruments as the tools used by the researcher to generate data. In this study the research instruments used to generate data to answer the research problem, were semi-structured interview schedule and focus group interview guide.

Semi-structured Interview Guide

Mills (2016) defines a semi-structured interview as a procedure of interviewing that allows for flexibility of questioning in the interview.

Advantages

Oppie (2004)) cited in Maifala (2017) notes that semi-structured interviews allow the researcher to ask probing questions that require participants to think, reflect and talk. As participants were offered the opportunity to articulate about their lived experiences on enhancing Mathematical problem solving among Form Four learners on using Information Technology, they provided insights of the meanings and understanding they attached to their ICT use in mathematics teaching. The provision of open-ended questions in semi-structured interviews allowed the participants the

opportunity to speak at length and the use of Shona and English enhanced the creation of rapport and provided effective expression from the participants (Maifala, 2017).

Disadvantages

De Trigueros & Sandoval (2017) argue that semi-structured interviews are claimed to minimize the researcher's control over the interview and is time consuming to undertake and analyse the generated data. This entails that semi-structured interviews require a limited number of participants. In this study three participants were involved in semi-structured interviews to enable the researcher to manage the interviews. Thus, conducting interviews, transcribing, data analysis, giving feedback and report writing is time consuming (Chinooneka, 2020). Chinooneka (2020) argues that researchers when conducting semi-structured interviews may be biased and ask closed questions, as a result compromising the data generated.

Ways of overcoming weaknesses of Semi-structured interviews

To maximize control over the interviews the research ensured that participants were kept focused on the research questions through asking the participants questions in diverse ways to ensure they are kept focused on the research questions. In addition, great effort was made to ask bias free questions and the researcher was objective as possible to ensure participants were free from researcher's influence. Thus, the researcher engaged in the study without any preconceived notions to ensure data generation was flexible.

Focus Group Interview Guide

Jakachira (2020) defines a focus group interview as a collective in-depth interview facilitated by the researcher to generate rich and thick data. In this study, three Mathematics teachers from each of the selected secondary schools underwent focus group interviews with the researcher to explore

enhancing Mathematical problem solving among Form Four learner using Information Technology.

Advantages

FGI are important especially when the participant's interaction and discussion is likely to draw out extra information which the y would not otherwise have released (Guvhu, 2018). Chisaka (2013) cited in Chinooneka (2020) says focus group interviews are productive when the context is permissive, accommodating and friendly. The researcher ensured a conducive environment through the creation of rapport and prolonged engagement of the participants to ensure data generation in a comfortable environment. Denzin and Lincoln (2018) cited in Jakachira (2020) assert that focus group interviews are undertaken with participants in their natural contexts and this is in line with the naturalistic nature of qualitative research. Thus, in this study the researcher conducted the focus group interview with the participants in their schools to give them the freedom and flexibility to participate in the study. Stewart and Shamdason (2014) cited in Akyildiz and Ahmed (2021) say through group interaction synergy effect is created on participants. In the study the use of focus group interview provided the participants with the opportunity to make meaningful contributions to the research problem based on insights provided by one participant which triggered more insights to be given.

Disadvantages

Akyildiz & Ahmed (2021) contend that focus group interviews cannot be utilized to develop assumptions concerning larger populations. In this case, findings that were generated from the study through focus group interviews cannot be generalized to a large number of settings. In addition, there is a tendency for group participants to accept ideas put across by other participants

(Akyildiz & Ahmed (2021). In this case, the exploration of complex ideas based on individual perspectives was limited in focus group interviews.

Ways of overcoming weaknesses of Focus Group Interviews

The weakness of participants accepting ideas put across by other participants, the researcher ensured that each participant in the focus group interview was afforded a chance to express his or her views and perspectives in relation to the research problem. While the findings from focus group interviews cannot be generalized the researcher ensured there was prolonged engagement with participants and thick descriptions were drawn from the participants.

3.3.3 Data collection methods

Creswell (2013) cited in Mills (2016) asserts that data collection entails obtaining permission, undertaking good qualitative sampling, developing means for recording information both digitally and on paper, storing the data and anticipating ethical issues that may arise. In light of this, the researcher sought an introductory letter from Bindura University of Science Education (BUSE) that she used the letter to seek authority from Ministry of Primary and Secondary Education (MOPSE) provincial offices to conduct research in Sanyati District in the selected cluster and five secondary schools. After getting the letter of authorization, the researcher visited Sanyati District MOPSE offices to have the letter of authorization endorsed by the District Schools Inspector (DSI). Thereafter, the selected schools were paid a visit and the researcher introduced herself and presented to the head the authorization letter. In the process the researcher explained the purpose of her study, its significance, objectives, data generation procedures and the participants to the study. Through the permission of the head the teacher participants to the study, those who taught mathematics were briefed on the study's programme. This was done for all the selected schools,

school heads and participant teachers. In the process the participants' voluntary consent to participate in the study was sought. The participants were informed of the right to informed consent, anonymity, confidentiality, right to withdraw from the study should they feel to do so and freedom from harm. Upon giving consent to the study, the participants were asked to complete consent forms. Thereafter, preliminary arrangements were made on interview dates for school heads and focus group interviews for selected teachers. Finally, the researcher left the school having emphasized data generation dates. Data generation from school heads cross checked data from mathematics teachers through having similar questions and this triangulation of data generation methods, study sites and research participants is noted by Jakachira (2020) to help in enhancing trustworthiness of the study findings.

3.3.4 Data analysis methods

Ngonyani (2017) says data analysis is a search for patterns in data, recurrent behaviours, objects or body of knowledge. In this study, thematic analysis was used in analyzing generated data to ensure that recurring and emerging themes were reported on. In addition, data analysis is data presentation, discussion and interpretation (Francis, 2021). The researcher engaged in data analysis working from the interviews transcripts and guided by the themes from the school leaders and teachers formed the grounds for the interpretation of the conceptual understanding of enhancing mathematics problem solving among form four learners using information technology.

3.3.5 Qualitative Data Analysis

Data analysis is noted to be critical in qualitative research (Maguire & Delahunt, 2017). In this study thematic analysis was utilized in analyzing generated data from the study and Maguire & Delahunt (2017) define thematic analysis as the process of identifying themes or patterns that come

up within qualitative data. In addition, Braun, Clarke, Hayfield & Terry (2018) cited in Jakachira (2020) view thematic analysis as a method of identifying pattern or themes of meanings across a data set concerning the research questions. In this case, the researcher made use of thematic analysis to analyse generated data concerning enhancing mathematical problem solving among form four learners using information technology. Through thematic analysis recurring themes and categories enhancing mathematical problem solving among form four learners using information technology were established. Braun & Clarke (2013) cited in Maguire & Delahunt (2017) provide a six-step guide in undertaking thematic analysis which are; organizing the data; immerse on in the data; generating codes, generating categories; generating themes and data and producing the report. These are the steps that were used in analysing data generated from the study. Thematic analysis was important as it showed the frequency with which particular themes emerged from participants especially on qualitative data. Thus, this provided the degree to which the issue under consideration was viewed by the participants based on their perceptions, experiences and how they viewed the problem being studied. After coming up with emerging themes, the analysed data were utilized in report writing. Javadi & Zera (2016) argue that while thematic analysis' high level of flexibility and simplicity and tangibility of analysis phase makes it easy for novice researchers to be attracted towards this method some potential pitfalls may result in weak analysis and they should be dealt with. Bias can emerge in thematic analysis therefore it is important that the researcher be objective in undertaking thematic analysis.

3.4 Trustworthiness

Stahl and King (2020) say trustworthiness is created as a result of certain research procedures that researchers undertake. In qualitative research trustworthiness according to Maifala (2017) is what

validity and reliability are to quantitative research and he adds that it is the measure of trustworthiness with which the research results can be utilized to ensure trustworthiness of qualitative research findings. Strategies that were used to ensure trustworthiness in this study were credibility, transferability, dependability and confirmability

3.4.1 Credibility

Mamba (2019) says credibility is a strategy of ascertaining that the researcher's findings are true and accurate. In this study, to ensure that the study measured what it was supposed to measure, that is, establish enhancing mathematical problem solving among form four learners using information technology, the researcher used research questions cited in Chapter one to come up with a guide for semi-structured interviews and focus group interviews. In this case, a triangulation of these two data generation tools also enhanced credibility for the study and the study allowed participants to communicate both in English and vernacular, Shona, to ensure that they provided thick descriptions of their use of ICT in enhancing mathematical problem solving thereby providing more credible accounts for their experiences.

3.4.2 Dependability

Shento (2004) cited in Maifala (2017) defines dependability as the level with which future research can be repeated and attain similar findings. In an effort to ensure dependability of the study the researcher periodically submitted his research progress to his supervisor for scrutiny as this ensured trust. In addition, the researcher kept a log book where she recorded different activities that were critical to the study which included visits made to the selected schools, dates of visit, individuals met and activities before, during and after data collection. All these activities and records helped to give dependability to the study

3.4.3 Transferability

Lichtman (2009) cited in Guvhu (2018) defines transferability as the degree to which findings can be transferred to other contexts. In order to ensure transferability of the research findings the researcher made an effort to ensure that she got thick descriptions of the manner in which participants were enhancing mathematical problem solving among form four learners using information technology in selected secondary schools. This ensures that the readers of the research study would have an enhanced understanding of the study findings. Thus, it is significant that adequate thick descriptions of the research problem under study are given to allow readers a proper comprehension of the problem (Reid, 2022). The researcher as she engaged in data generation ensured that there was probing and provision of thick descriptions to ensure that transferability is enhanced

3.5 Ethical issues

In this study, the ethical considerations that were taken into consideration were informed consent, confidentiality, anonymity and freedom from harm. The ethical considerations were observed to ensure that the research participants' dignity and freedom from harm were assured. Arifin (2018) asserts that it is crucial to observe ethical issues throughout all qualitative study stages to maintain the nexus between the potential risks of research and the perceived benefits of the research. Thus, Buckley (2015) as cited in Guvhu (2018) says the primary reason for ethical considerations is to ensure that researchers and participants are kept in line with the best research practices

3.5.1 Right to informed consent

Kachali (2020) views informed consent as informing potential participants to a study in advance and in understandable terms of any benefits, risks, inconvenience or obligations attached with the

research that might reasonably be expected to influence their willingness to participate. In this study, the participants were educators who were expected and assumed to readily understand the study. However, the participants were informed of the study's objectives, the significance of the study and its demand on their time. In this case, after informing the participants adequately of the study, the participants gave their informed consent by completing consent forms.

3.5.2 Right to confidentiality

Creswell (2012) cited in Ghimire (2021) posits that confidentiality is a form of secrecy that safeguards the privacy of the participants. This demands that research participants should not be named and Mertens (2015) cited in Chinooneka (2020) posits that confidentiality is the privacy of individuals which must be safeguarded in that the data they provide must be handled and reported in a manner that the data cannot be linked personal to the research participants. Thus, Ghimire (2021) reports that confidentiality means that while a participant could be conceivably identified only the researcher collecting and analysing data has access to participant's personal information and this information is not shared in any manner that would allow individuals to be identified. In an effort to ensure confidentiality, the researcher provided assurance to the participants that there was non-disclosure of generated data and ensured restricted access to data which named the participants through keeping recorded audios in an encrypted folder in the researcher's smart phone. Even the documents that captured the names of the participants were kept in a locked drawer to ensure that there was no unauthorised access to the documents.

3.5.3 Right to anonymity

Halej (2017) defines anonymity as entailing there is no way to identify a person from the information provided. In addition, Ketefian (2015) says anonymity means data cannot be identified

to a particular participant. According to Mertens (2015) cited in Chinooneka (2020) this entails that no uniquely identifying information is attached to the data and thus no one can link and trace the data generated back to the participant who provided them. Ghimire (2021) says anonymity is maintained by the qualitative researcher using pseudonyms. In this study, the names of schools were assigned letters A; B; & C Heads from the respective schools were named HSA; HSB & HSC and teachers who participated in the study from the three schools were named T1SA; T2SA & T3SA; T1SB; T2SB & T3SB; and T1SC; T2SC & T3SC. Assigning these pseudonyms to the schools, Heads and Mathematics teachers ensured that the research participants and their schools remained anonymous and this protected them from foreseen or unforeseen harm.

Kamal (2021) points out that in any research there is need to minimize harm and this encompasses harm for the research participants and the researcher. In this case, the researcher as she briefed the participants she explained thoroughly risks if any and benefits that came with participating in the study so that the participants participated in the study being fully aware of what the study could benefit them and the risks that came with it. Thus, informing participants on any harm, if any that could befall them as they decided to participate in the study ensured that when they made the decision to participate in the study their decision was voluntary and based on informed consent.

3.6 Chapter summary

The chapter focused on research methodology covering areas which are research paradigm, constructivism, and its ontology, epistemology and axiology, research approach which is qualitative research approach and justification of the research approach for the study. In addition, the research design for the study was elaborated and the design which was the multi-case study design, its strengths, weaknesses and ways of overcoming weaknesses of the multi-case study

design. Besides, research instruments were defined followed by the description of each research instrument for the study, semi-structured interview, its strengths, weaknesses and ways of overcoming weaknesses of semi-structured interview and focus group interview, its strengths, weaknesses and ways of overcoming weaknesses of focus group interviews. Further, strategies of ensuring trustworthiness were covered under the sub-headings; credibility, transferability, dependability, audit trails and member checks. Population, purposive sampling procedures and purposive sampling for selecting school heads and Mathematics teachers was covered under methodology. Not only that, sample, data generation procedure and its sub-headings collecting data using semi-structured interview schedule and collecting data using focus group interview schedule. Finally, data analysis and ethical considerations were covered. The ethical considerations were covered under the sub-headings right to informed consent, right to confidentiality, right to anonymity and freedom from harm.

CHAPTER 4

DATA PRESENTATION, ANALYSIS AND DISCUSSION/INTERPRETATION

4.1 Introduction

In this chapter the researcher focused on data presentation, analysis and discussion. First, demographic information of participants is presented followed by presentation of data generated from the participants. Thereafter, data analysis and discussion will be done thematically, drawing from the data presented as given by the research participants.

4.2 Presentation of Demographic Data

This section presents demographic data of participants.

4.2.1 Participants' Demographic Information

4.2.2 Gender of Participants

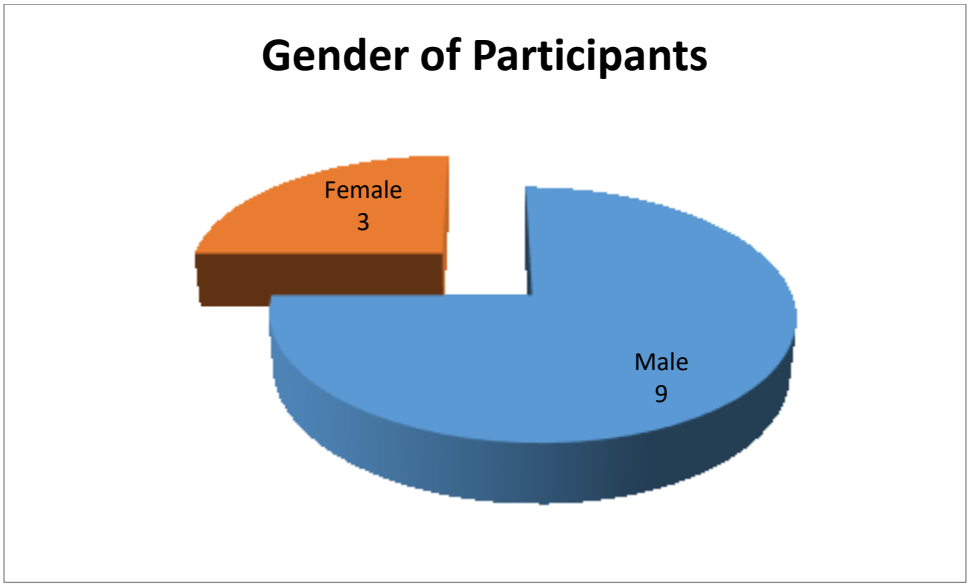

Figure 4.1: Gender of Participants

Based on Figure 4.1 there were nine males and three females who participated in the study indicating gender imbalance, meaning perceptions given were male oriented.

4.2.3 Age of Participants

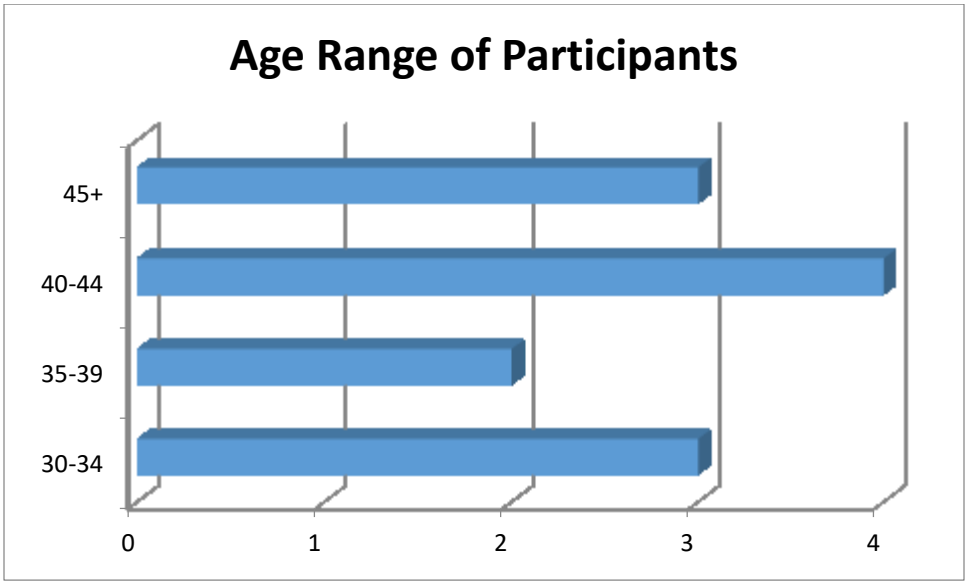

Figure 4.2: Age Range of Participants

As given in Figure 4.2 the majority of the participants, four (4) were in the age range 40-44 years, followed by three (3) who were in the 45+ age range and three (3) again who were in the 30-34 years age range. Finally, two participants were in the 30-34 years age range. The age range exhibits both young middle age and mature participants indicating that the views provided by the participants were varied and representative of different age groups.

4.2.4 Educational Qualifications of Participants

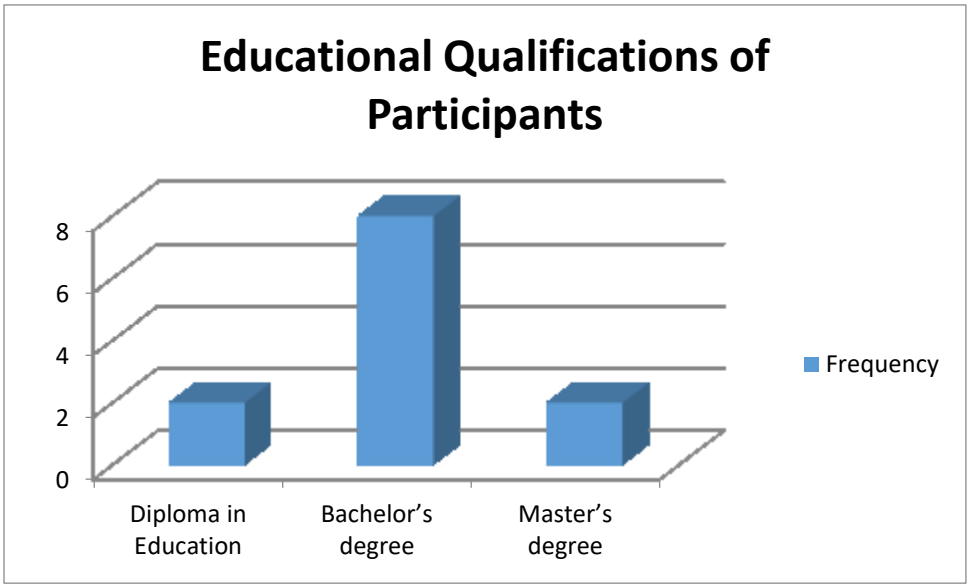

Figure 4.3: Educational Qualifications of Participants

From Figure 4.3 it is evident that the majority of the participants, eight (8), had Bachelor's degree as the highest qualification followed by two (2), who had master's degree and two (2) who had Diploma in education as the highest qualification. It is evident that the majority of the participants were more knowledgeable in mathematics due to their level of education and their contributions to the study were more informed.

4.2.5 Work Experience of Participants

Table 4.1: Work Experience of Participants

Years range	6-10	11-15	16-20	21+
Frequency	2	2	6	2

From Table 4.1 the majority of the participants' work experience was in the 16-20 years range and the 6-10; 11-15 and 21+ years range there were two participants in each category. The work experience for the majority of the participants, ten (10), was above ten years an indication that the information given by participants exhibited maturity and depth in relation to the research problem.

4.3 Data Presentation, Analysis and Discussion from interviews

This section presents data analysis and discussion under the three objectives that guided the study and under each objective there are themes that emerged from the study.

4.3.1 ICT tools used in Mathematics education

The IT tools that emerged from the study to be dominant in the three selected schools were calculator, smartphones, laptops and desktops, internet and WIFI resources and interactive boards and whiteboards. These themes are shown in Table 4.1 below and are analysed and discussed below, thus;

Table 4.2: ICT tools used in Mathematics Education

Category	ICT tools used in Mathematics Education							
Participant	**Calculator**	**Smartphone**	**Laptops**	**Desktop**	**Internet/WiFi**	**Interactive Board**	**White Board**	**Software**
HAS	✓		✓	✓	✓			
T1SA	✓							✓
T2SA	✓							
T3SA	✓							
HSB	✓		✓		✓	✓	✓	
T1SB	✓						✓	
T2SB	✓	✓			✓			
T3SB	✓	✓				✓		
HSC	✓	✓						
T1SC	✓		✓					
T2SC	✓							
T3SC	✓							

Calculator

The calculator emerged as the major IT tool used in all the schools as indicated by all the participants (12) to the study.

Thus, all the participants to the study indicated that the calculator was the most used IT tool in the teaching and learning of mathematics. T1SA had this to say;

Calculators are the major ICT tools being used by learners in learning mathematics and they seem to have enhanced learners' skills in learning mathematics.

These findings of learners predominantly using calculators corroborate with findings made by Lucas and Cady (2012) cited in Sheila (2016) assert that educators can make use of calculators to give activities that assist learners to develop their mathematical understanding about different concepts.

Smart phones

Three out of the twelve participants from the study indicated that Smartphones were used as ICT tools in mathematics teaching. This was reiterated by T2SB; T3SB and HSC. T2SB had this to say;

Learners normally use calculators and smartphones connected to school WIFI as they learn mathematics. Most learners seem to be comfortable with these two IT tools than they are with laptops and desktops.

The utilisation of smart phones in mathematics education is in sync with findings made by Hoofman (2006) cited in Nicolete et al., (2017) who asserted that mobile learning involves the use of mobile technology in education to produce and educational experience anywhere and anytime.

Laptops and Desktops

In addition, three out of twelve participants, HAS; HSB and T1SC revealed that laptops and desktops (HSA) were used a ICT tools in mathematics teaching in their schools and T1SC had this to say;

We use personal laptops and calculators in mathematics education. Other IT tools are yet to be used because they are scarce in our schools and smartphones are forbidden in the school. This has seen using limited IT tools in mathematics education.

There is evidence from the study that computers were being used in mathematics education and these findings are in tandem with findings made by Pannen (2015) who posited that computers enables students to work with real data which can be represented in a variety of ways and this supports interpretation and analysis that leads learners to higher order thinking skills

Internet and WIFI resources

Furthermore, three participants out of twelve, HAS; HSB and T2SB reported that WIFI and internet resources were being used in the teaching of mathematics in their schools and T2SB reported that;

Laptops connected to the internet have proved to be helping learners to solve diverse mathematical problems as they can now not only access written text but also video, audio and graphics. This has inspired and thrilled learners to approach mathematics with a different dimension.

The use of online resources corroborates with findings made by Sue et al., (2024) where it was reported that both teachers and learners can use the internet to gather information, knowledge, concepts and data access resources for downloading, interact directly with interactive content and communicate mathematically with others. This indicates that the internet is a repository of unlimited mathematics resources.

Interactive boards and whiteboards

Finally, interactive boards and white boards were mentioned by three out of twelve participants as ICT tools used in mathematics teaching in schools. This is an indication that these resources were being used in one school, SB, and HSB had this to say;

The school has two interactive boards, calculators, whiteboard, tablets, laptops and WIFI connectivity it received as a donation. These IT tools are at the learners; disposal for learning mathematics.

The provision of interactive boards in mathematics education is supported by findings made by Starja et al., (2020) where it emerged that the use of interactive whiteboards (IWB) is one of the technological innovations that are being widely introduced in private schools in Albania and less in public schools in teaching in general and in teaching Mathematics in particular

4.3.2 Impact of ICT on students' problem-solving skills

The major themes that emerged from the study on the impact of ICT on students' problem-solving skills were increased confidence and motivation, improved speed in task completion, increased access to diverse resources and limited skills due to IT limited tools. These themes are represented in Figure 4.4 below. Thereafter these themes are analysed and discussed below, thus;

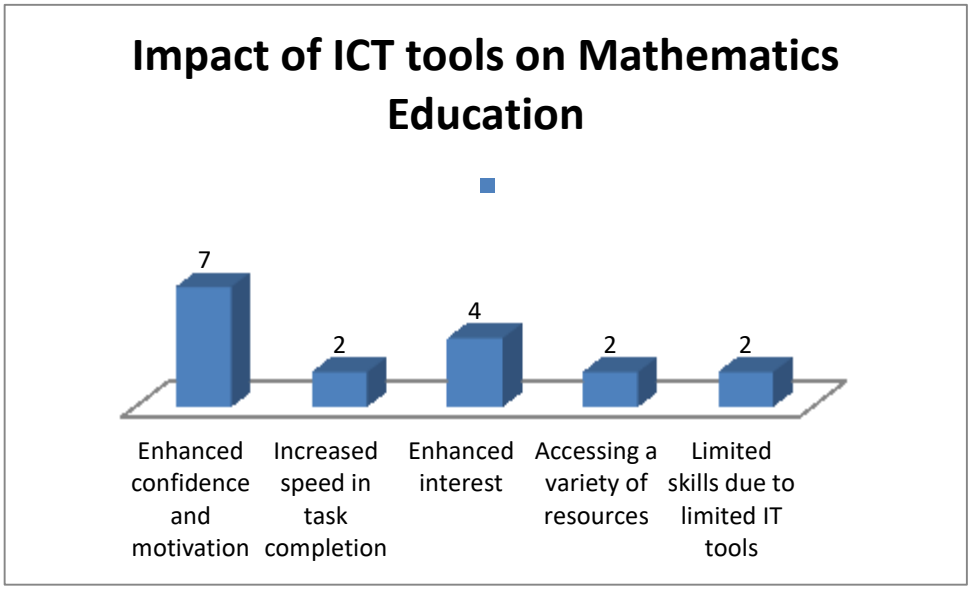

Figure 4.4: Impact of ICT tools on Mathematics Education

Figure 4.4 above shows the impact of ICT tools on Mathematics Education as reported by participants who took part in the study. The major themes that emerged from the particiipants were enhanced confidence and motivation, increased speed in task completion, enhanced interest, accessing a variety of resources and limited skills due to limited IT tools. these are discussed in detail below.

Increased confidence and motivation

The major theme that emerged from the study on the impact of ICT on students' problem- solving skills was increased confidence and motivation as given by seven out of twelve participants who took part in the study, thus, T1SA; T3SA; HSB; T1SB; HSC; T1SC and T2SC. T1SB had this to say;

Learner motivation has increased through the use of calculators and interactive boards. In addition, the availability of internet connectivity has given form four learners a cutting edge in

solving mathematical problems. Learners through smartphones are now accessing YouTube videos which make mathematical problems easy to solve.

The use of ICT tools' boosting of learners' confidence as found by this study corroborates with findings made by Bowker et al., (2009) as cited in Sawyerr (2021) where it emerged that calculators enhance learners' confidence in the accuracy of their graphs enabling them to operate autonomously from the teacher. in addition, this was also supported by a study made by Ku et al., (2014) cited in Ashiono, Mwama and Murungi (2015) where it emerged that digital game-based learning significantly enhanced children's level of confidence in Mathematics.

Improved speed in task completion

In addition, ICT tools were noted to improve speed in task completion by two out of twelve participants, HAS and T3SB, who participated in the study. T3SB had this to say;

Learners are now able to manipulate calculators with amazing speed and they are able to finish standard mathematics papers in time and this is an indication that their problem-solving skills have been enhanced through the use of calculators.

These findings relate to findings made by Pastor and Pedro (2023) who found that the integration of ICT plays a significant role in enhancing problem solving skills and Leite (2019) cited in Pastor and Pedro (2023) contend that research has shown that ICT can assist learners in developing higher order mathematical thinking and problem solving.

Enhanced interest

It emerged from T2SA; HSB; T1SB and T2SB that ICT tools enhanced pupils' interest in Mathematics Education. The HSB has this to say;

> *Learners have become more interested in mathematics through the use of these IT tools and their interaction with other peers has increased. Even teachers are also being engaged more than previously when the school had no IT tools. Consequently, the learners' problem-solving skills in mathematics and in life generally have improved significantly.*

Increased access to diverse resources

Furthermore, the use of ICT tools was reported to have resulted in increased access to diverse resources available in mathematics teaching. This was reported by four out of twelve participants who took part in the study, T1SB and T2SB. T2SB had this to say;

Laptops connected to the internet have proved to be helping learners to solve diverse mathematical problems as they can now not only access written text but also video, audio and graphics. This has inspired and thrilled learners to approach mathematics with a different dimension.

The access to diverse resources available is in sync with findings made by Ashiono et al., (2015) where it emerged that ICT provides learners with advanced communication tools what allow them to use graphics, images, sound and text in their course of learning. In this regard, ICT tools are empowering and open increased opportunities to learn and understand mathematics.

Limited skills due to limited IT tools

However, it also emerged from the study that the use of ICT tools in mathematics education has resulted in some learners having limited skills in mathematics due to the unavailability or limited IT tools available to them. Thus, this was reported by T2SC and T3SC where T3SC had this to say;

The limited IT tools in the school has made learners to have limited skills in IT tools manipulation making them to lag behind in IT tools use

4.3.3 Guidelines and recommendations for effective ICT integration into Mathematics Teaching

The major themes that emerged from the participants on guidelines and recommendations for effective ICT integration into Mathematics teaching were teacher and leadership training, ICT policy, multi-sector approach, adequate resource provision and integrated curriculum development. These themes are shown in Table 2.3 below, interpreted and discussed thereafter, thus;

Table 4.3: Guidelines and recommendations for effective ICT integration into Mathematics teaching

Guidelines and recommendations for effective ICT integration into Mathematics teaching	**Frequency**	**Percentage**
Teacher and leadership training	**6**	**50%**
ICT Policy	**3**	**25%**
Multi-sector approach	**3**	**25%**
Adequate resource provision	**3**	**25%**
Integrated curriculum development	**2**	**16.67%**

n=12

From Table 4.3 it is evident that five themes emerged from the study on guidelines and recommendations for effective ICT integration into Mathematics teaching which are; Teacher and leadership training; ICT policy; multi-sector approach; Adequate resource provision and Integrated curriculum development. These themes are analysed and discussed below, thus;

Teacher and Leadership training

Teacher and leadership training emerged as the major theme on the guidelines and recommendations for effective ICT integration as reported by HSA; T1SA; T3SA; HSB; T1SB and T2SB. The HSA had this to say;

There is need for the school teachers to be trained in different ICT tools and software used in teaching and learning to enhance their ability to embrace and use different tools.

T3SA weighed in and said**;**

In terms of guidelines there is need for teacher and leadership capacitation on ICT use in teaching and learning. This will empower teachers and school leaders on how ICT can be a game changing agent in teaching and learning. Thereafter, integration of ICT in mathematics teaching and learning will flow with ease as it will be done by knowledgeable individuals who understand the role of ICT in teaching mathematics

ICT Policy

The introduction of school policy also emerged as a theme from the study where participants, T3SB, HSC and T3SC suggested the need for the schools to have ICT Policy that would guide the schools in their integration of ICT in Mathematics teaching. on this issue the HSC had this to say;

The existence of a clear policy on ICT is imperative without which IT integration not only in mathematics but in all learning, areas would be a challenge

This was supported by T2SB who said;

The school should have an ICT policy that should be reviewed and revised from time to time to ensure that IT integration becomes mandatory as guided by school policy. The policy should be backed by financial, material and human resources to ensure that it becomes a success story.

Multi-sector Approach

The multi-sector approach guideline in integrating ICT for mathematics teaching was reiterated by T1SB; T1SC and T2SC. The T1SB had this to say;

The integration of IT effectively into mathematics teaching cannot be accomplished by the Ministry of Primary and Secondary Education (MOPSE) on its own. There is need for a multi-sector approach where mathematics software developers, curriculum developers, the corporate world and civic organisations that have an interest in education come together and work on the development of a robust mathematics curriculum that will be taught in schools. This will be followed by staff development of teachers and educational mangers to ensure that both the implementers and the supervisors are equipped with the requisite skills needed to integrate IT effectively in mathematics teaching.

Adequate resource provision

Resources were noted to be of great significance in implementing guidelines and integration of ICT for mathematics teaching and this was noted by T3SB; T2SC and T3SC. The T2SC had this to say;

Adequate funding is needed coupled with the active involvement of capable human capital to design a needs responsive curriculum supported by trained human resources to ensure effective IT integration in mathematics education.

Integrated curriculum development

Finally, the participants also noted the need for integrating ICT in mathematics teaching as a guideline in integrating IT for mathematics teaching. This was revealed by T1SA and HSB and HSB had this to say;

The Curriculum Development and Technical Services (CDTS) should be the starting point if IT is to be integrated effectively into mathematics teaching. This entails that there is need for the CDTS to develop mathematics curriculum that incorporates IT tools. Second, teacher capacitation becomes mandatory for them to be able to implement the curriculum that embraces IT. Thereafter, IT can now be integrated into mathematics teaching.

SUMMARY

In this chapter data presentation was done as obtained from research participants and later data interpretation and discussion was presented where themes that emerged from the study were presented in line with the research objectives. In addition, supporting literature as reviewed in chapter two was also quoted where it corroborated with the themes that emerged from the study. The next and final chapter of the study presents summary, conclusions and recommendations of the study as they relate to the data provided and analysed generated from the research participants.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The chapter begins by giving a summary of the study noting what was covered in chapters one, two, three and four. In addition, conclusions that were arrived at by the study are given based on the research objectives that guided the study. Furthermore, based on these conclusions' recommendations are given as they draw from the conclusions made by the study.

5.2 Summary of the study

Chapter one of the study presented the research problem as it relates in the context that was under study. This gave an overview of the study where the research objectives and questions were presented as guidelines for the study.

Chapter two presented review of related literature as guided by the research objectives for the study. In this case, literature was reviewed focusing on the identification of IT tools used in mathematics teaching in schools, the impact of IT tools on learners' problem-solving skills and the guidelines in integrating ICT for mathematics teaching.

Chapter three dwelt on research methodology where the research paradigm approach, strategy and design were elaborated. Research instrument used for the study were discussed, data collection procedure and data analysis were explained.

Chapter four presented data generated from participants and after data presentation there was data interpretation and discussion. Research objectives stated in chapter one was presented in terms of themes that emerged from the data analysed as given by the research participants.

5.3 Conclusions

Based on the research findings that emerged from the study, the researcher reached the following conclusions. First, based on the first objective that sought to identify IT tools used in

Mathematics teaching the study concluded that there were still limited IT tools used in mathematics teaching in schools and the learners were yet to fully understand how to use these IT tools.

In addition, based on the second objective that sought to assess the impact of IT on students' problem-solving skills through empirical studies it was concluded that IT motivated and empowered learners in problem solving and gave the learners confidence to showcase their learned skills.

Finally, on the third objective which sought to develop guidelines and recommendations for integrating IT effectively into mathematics teaching it was concluded that ICT policy, multi-sector approach and provision of resources were fundamental in integrating IT into mathematics teaching.

5.4 Recommendations

Based on the research findings and conclusions drawn from the study the researcher makes the following recommendations

- School leadership needs to be trained, developed and prepared for the use and implementation of ICT tools not only in mathematics but across the curriculum's different learning areas.
- There is need to enhance the utilisation of ICT tools in the teaching and learning of mathematics considering that ICT has been noted to be influential and highly motivational.

- The MOPSE need to engage different stakeholders to develop a robust IT based mathematics curriculum that require the use of IT tools in teaching and learning, formative and summative assessment.

5.5. Areas for future research

The study focused on school heads and Mathematics teachers utilizing a qualitative approach. the researcher recommends further undertaking the study using a mixed methods approach to get balanced results that are both qualitative and quantitative in nature. in addition, there is need to include Mathematics learners in future studies to ensure that a snapshot from the pupils' perspectives can be included in the study. Finally, there is need to include organizations like Zimbabwe Schools Examination Council (ZIMSEC) and Curriculum Development and Technical Services (CDTS) to further understand how Mathematics curriculum are assessed and developed.

REFERENCES

Ashiono, B., Mwoma, T. and Murungi, C. (2015). *Does the use of ICT empower teachers to teach mathematics better? A case of lower primary teachers in Mombasa, Matters of Behavior* www.mattersofbehaviour,org

Ata-Baah, D. (2020). *What is the impact of ICT on mathematics education? Doctoral Dissertation,* Selinus University of Science and Literature.

Baki, A. & Amid, A. (2015). The use of graphing calculators in Teaching ang leaning mathematics: A systematic review. Eurasia Journal of Mathematics, Sciences & Technology Education, 11(5), 1141-1154.

Chesitt, P. C. B. (2015). *Impact of ICT integration on mathematics performance in Kenya: A case study of public secondary schools in West Pokot County,* Master's Research Project, University of Nairobi

Chinaka, G. (2017). *Factors affecting the adoption and integration of ICT as a pedagogical tool in rural primary schools.* Bachelor's Dissertation, Midlands State University.

Das, K. (2019) Role of ICT for better mathematics teaching. *International Journal of Education Volume 7, Issue 4, pp. 19-28*

Demetriou, K. (2019). *Using ICT for word mathematical problem solving for students with dyslexia in Cyprus,* International Conference The future of education 2nd edition University of Leeds

Dhakal, P. (2018). Use of ICT tools in teaching mathematics in higher education: A case of Mid-Western University. *International Journal of Multidisciplinary Perspectives in Higher Education Volume 3, Issue 1, pp. 81-88*

Gachinu, J. T. (2014). *Influence of ICT integration on performance in mathematics in public secondary schools* – Embu North District of Kenya

Joshi, D. R. (2017). Influence of ICT in mathematics teaching. *International Journal for Innovation Research in Multidisciplinary Field Volume 3, Issue 1, pp. 7-1.*

Kahlan, M. (2016). Virtual manipulatives: An effective tool for mathematical practices in a virtual world, international Journal of science Mathematical Education, 14(1),101-124

Khomo, T. G. (2018). *The use of information and communication technology by mathematics and physical science teachers at secondary schools,* Master's Dissertation, University of South Africa.

Musa, D. C. and Garba, A. (2019). Effect of using ICT in learning mathematics in selected secondary schools in Makurdi Metropolis. *Journal of Advance Research in Mathematical Statistics Volume 6, No. 7, pp. 12-22.*

Musembi, D.C and Garba, A. (2019). Effect of spread sheets on learner' problem-solving abilities in high school mathematics. Journal of scientific and research publications, (7),1-8.

Namita Saxena, (2017). The role and impact of ICT in improving the quality of education an overview international journal the engineering sciences & research technology.

Netsianda, A. and Rumaila, S. (2021). *The use of ICT in mathematics teaching and learning in South African secondary schools,* Conference Paper, pp. 1-11

Nicolete, P. S., Blessimo, S. M. S., Cristiano, C., da Silva, M. A., Simalo, J. P. S. and da Silva, J. B. (2017). Technology integration actions in mathematics teaching in Brazilian Basic Education Stimulating STEM disciplines. *Revista de Educacion aDistancia Num 52, Artic 7, pp. 1-22*

Niem, M. M., Verina, R. U. and Alcantaro, E. C. (2020). Teaching and learning with technology: Ramification of ICT integration in mathematics education. *Southeast Asia Mathematics Education Journal Volume 10, No. 1, pp. 27-40*

Niyibizi, O. and Mutatutinya, V. (2024). The use of ICT facilities in mathematics education. *International Journal of Studies in Education and Science Volume 5, No. 2, pp. 140-149*

Nteziryimama, J. and Niyobuhungiro, J. (2023). *Impact of ICT integration on performance in mathematics in public secondary schools in Huye District, Rwanda*

Pannen, P. (2015). *Integrating technology in teaching and learning mathematics*, Ministry of Education and Culture, Indonesia

Pastor, M. J. D. and Pedro, L. A. C. (2023). Mathematics teachers' levels of ICT expertise and use and their beliefs about ICT integration and students' problem-solving skills. *Southeast Asia Mathematics Education Journal Volume 13, No. 1, pp. 56-72*

Qizi, A. M. A. and Wuydinjonovna, E. H (2020). Technological method in teaching mathematics. *European Journal of Research and Reflection in Educational Sciences Volume 8, No. 6, pp23-30*

Rei, M.M. (2018). Just-in time learning or learning communities. Abu Dhadi: The fourth Annual conference of the Emirates center for studies and Research, pp.18.

Sawyerr, A. (2021). *Exploring mathematics teachers 'perceived use of ICT in classroom instruction using the Will-Skill-Tool pedagogy model*, Master's Thesis, University of Cape Coast

Sheila, A. O. (2016). *Integrating information communication technology in mathematics education at secondary level, a case of Nairobi County, Kenya*, Master's Thesis, Kenyatta University

Sivakova, D, Jasminka, K, Marija, R and Bijana, G, (2017). ICT -the Education Programs in Teaching Mathematics, stem journal, volume 6 issues, pages 469-478, Dol: 10. 18421 TEM 63-mathematics learning on online environments.

Starja, B., Shity, B. and Nikolova, N. (2020). The role of ICT in improving problem solving in teaching mathematics. Conference Paper Sofia University St Kliment Ohridski pp. 2650-2659

Voogt, D. D. A. J. (2010). ICT use in the teaching of mathematics: Implications for professional development of pre-service teachers in Ghana. Education Information Technology, pp. 1

Whitten, J. L.7 & Bentley, L.D. (2018). Systems Analysis and Design. Boston: Irwin/ McGraw. Hall.

APPENDIX I: INTERVIEW GUIDE FOR SCHOOL HEADS

My name is Gugugu Marilynn, a student at Bindura University of Science Education studying for a Bachelor's Science Honours Degree in Mathematics Education. I am carrying out research on Enhancing Mathematical problem solving among Form Four learners using Information Technology. The research is done in partial fulfilment of the requirements of the programme studied. You are therefore kindly requested to answer the following questions in honesty. Your responses will be treated in confidentiality and will be used only for the purposes of this study.

1. May you introduce yourself (name, age, professional qualifications, your position, professional experience as a whole and your experience at work).

2. What are the current practices challenges related to using IT in Mathematics education for form four learners?

3. How does the use of IT impact students' mathematical problem -solving abilities?

4. What strategies can be employed to effectively integrate IT into mathematics instruction for form four learners?

Thank you for your valuable time.

APPENDIX II: INTERVIEW GUIDE FOR MATHEMATICS TEACHERS

My name is Gugugu Marilynn, a student at Bindura University of Science Education studying for a Bachelor's Science Honours Degree in Mathematics Education. I am carrying out research on Enhancing Mathematical problem solving among Form Four learners using Information Technology. The research is done in partial fulfilment of the requirements of the programme studied. You are therefore kindly requested to answer the following questions in honesty. Your responses will be treated in confidentiality and will be used only for the purposes of this study.

1. May you introduce yourself (name, age, professional qualifications and professional experience).

2. What are the current practices challenges related to using IT in Mathematics education for form four learners?

3. How does the use of IT impact students' mathematical problem -solving abilities?

4. What strategies can be employed to effectively integrate IT into mathematics instruction for form four learners?

Thank you for your valuable time.

APPENDIX III: LETTER OF AUTHORITY TO COLLECT DATA IN SCHOOLS

All communications should be addressed to:
"The Provincial Education Director"
Telephone: 067-2123043/21633
Telex/Fax: 067-2123320
Email: mhomurkevet@gmail.com

ZIMBABWE

Ref: C/346/1/MW

Ministry of Primary & Secondary Education
Mashonaland West Province
P.O Box 328
Chinhoyi

19/06/2024

The District Schools Inspector
SANYATI District

AUTHORITY TO CARRY OUT EDUCATIONAL RESEARCH: SCHOOLS IN SANYATI

NAME: MR/MRS/MS CHIGORA MARILYNN
EC NO/IDNO 53023071L STATION MAMVURA MACHENA SEC.
DISTRICT SANYATI INSTITUTION BUSH
REG NO. R225828A PROGRAMME HRSc Ed MATHEMATICS

The above named student has been granted authority by the Provincial Education Director to carry out a research in SANYATI District. The student has been advised to visit your office before entering the school.

Research Topic Mathematics problem solving among learners in selected secondary schools in Kadoma urban district

Period of research March 2024 to June 2024

Targeted school/s KADOMA URBAN SCHOOLS

Method of research Questionnaires & Interviews

Please ensure that the learning and teaching programmes at the targeted schools are not interrupted in any way; the student strictly adheres to the activities and topics specified in his/her letter of request and that the research should be conducted according to the given time frame.

The District Schools Inspector is requested to liaise with the researcher on the specific schools where the research will be conducted and advise the Provincial Office of the chosen schools. Furthermore, the District Schools Inspector should ensure that a copy of the research findings is submitted to the Provincial Education Director once the research is completed.

T. MAKONI
FOR: ACTING PROVINCIAL EDUCATION DIRECTOR
MASHONALAND WEST PROVINCE

04 JUN 2024

MIN. OF PRY & SEC. EDUCATION
MASHONALAND WEST PROVINCE
HUMAN RESOURCES (DISCIPLINE)
04 JUN 2024
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