



# **BINDURA UNIVERSITY OF SCIENCE EDUCATION**

**TOPIC : THE IMPACT OF TECHNOLOGY ON STUDENTS ACHIEVEMENT IN MATHEMATICS AT FORM 3 LEVEL. A CASE OF NYAKUDYA SECONDARY SCHOOL IN MAZOWE DISTRICT.**

**BY**

**GUTSA MARIA**

**B225827A**

**A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONORS DEGREE IN MATHEMTICS**

**JANUARY**

**2025**

## RELEASE FORM

NAME OF AUTHOR: GUTSA MARIA

STUDENT NUMBER: B225827A

PROJECT TITLE: The impact of technology on student achievement in mathematics at form 3 level. A case at Nyakudya Secondary School in Mazowe District.

DEGREE: HONOURS BACHELOR OF SCIENCE EDUCATION, MATHEMATICS

YEAR AWARDED: 2025

Permission is hereby given to Bindura University of Science Education library to produce single copy of this dissertation for private, scholarly or scientific research purposes only. The author reserve other publication rights and the dissertation or extensive extracts from it may not be printed or otherwise reproduced without the author's written permission.



Signature.....

**PERMANENT ADDRESS : Muchirikuenda Primary School , Box 3018 Nzvimbo**

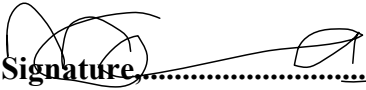
**EMAIL : mgutsa82@gmail.com**

**Cell number : 0776678504**

## APPROVAL FORM

The undersigned certify that they have supervised, read and recommended to Bindura University of Science Education for acceptance a research project entitled: The impact of technology in mathematics on student achievement in mathematics at form 3 level. A case at Nyakudya Secondary School in Mazowe District.

Submitted at Bindura University in partial fulfilment of the requirement of the Bachelor of Science Education Honours Degree in Mathematics.

Student  Signature .....

Date 20/ 12/24

Supervisor Signature ..... Date .....

Programme Coordinator's signature .....Date.....

Facult Chairperson's signature..... Date.....

External examiner's signature..... Date.....

## ACKNOWLEDGEMENTS

My sincere gratitude goes to my brother, Freeman Gutsa who was my pillar of strengths during this research study. Warm thanks to my supervisor, Dr Chagwiza who helped me through thick and thin circumstances to produce this research project and also the head and the staff of Nyakudya Secondary School for giving me permission to undergo my research at their school. Thanks to all teachers from mathematics department who were very cooperative during my research. I will not forget to thank form 3 students at Nyakudya Secondary School who participated in this project. I also want to thank my family for their long enduring support.

## DEDICATION

This research is a special dedication to all teachers especially in the mathematics department in our country and all lecturers. I hope those who go through these pages of the research will be able to draw inspiration on the importance of integration of technology in the teaching of mathematics.

## ABSTRACT

This research was conducted at Nyakudya Secondary School in Mazowe District. It was on the impact of technology on students achievement in mathematics at form 3 level. The researcher used the qualitative research design under which interviews and questionnaire were employed. The research was conducted over a period of 6 months. The key issues that the researcher sought to unveil were how the use of technology in mathematics affect students achievement at Nyakudya Secondary School and how does technology support teacher-student interaction in the mathematics classroom at Nyakudya Secondary School. The study will involve 4 teachers and 30 form 3 students at Nyakudya Secondary School and analysis of data collected from these participants through questionnaires, interviews and observations. The study finding could be used to develop recommendations on how to improve access to technology in remote areas especially rural schools in Mazowe District and other similar settings to enhance the teaching and learning of mathematics.

# Contents

---



|                                               |         |
|-----------------------------------------------|---------|
|                                               | ..... i |
| RELEASE FORM.....                             | ii      |
| APPROVAL FORM .....                           | iii     |
| ACKNOWLEDGEMENTS.....                         | iv      |
| DEDICATION .....                              | v       |
| ABSTRACT.....                                 | vi      |
| CHAPTER 1: INTRODUCTION TO THE RESEARCH ..... | 1       |
| INTRODUCTION.....                             | 1       |
| BACKGROUND OF THE STUDY.....                  | 3       |
| PURPOSE OF THE STUDY .....                    | 5       |
| STATEMENT OF THE PROBLEM .....                | 6       |
| RESEARCH QUESTIONS.....                       | 7       |
| DELIMITATIONS.....                            | 8       |
| LIMITATIONS .....                             | 9       |
| DEFINITION OF TERMS.....                      | 9       |
| CHAPTER SUMMARY .....                         | 11      |
| CHAPTER 2: LITERATURE REVIEW .....            | 12      |
| INTRODUCTION.....                             | 12      |
| THEORETICAL FRAMEWORKS .....                  | 12      |
| EMPIRICAL STUDIES .....                       | 13      |
| GAPS AND LIMITATIONS IN THE LITERATURE .....  | 18      |
| CHAPTER SUMMARY .....                         | 19      |
| CHPTER 3: RESEARCH METHODOLOGY.....           | 20      |
| INTODUCTION .....                             | 20      |

|                                                                            |    |
|----------------------------------------------------------------------------|----|
| RESEARCH DESIGN .....                                                      | 20 |
| RESEARCH PARADIGM .....                                                    | 21 |
| RESEARCH METHODOLOGY .....                                                 | 23 |
| RESEARCH METHODS.....                                                      | 23 |
| DATA COLLECTION METHODS/ INSTRUMENTS .....                                 | 24 |
| DATA ANALYSIS METHODS .....                                                | 27 |
| RELIABILITY AND VALIDITY .....                                             | 28 |
| CHAPTER SUMMARY .....                                                      | 29 |
| CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION/ INTERPRETATION..... | 30 |
| INTRODUCTION.....                                                          | 30 |
| PRESENTATION OF FINDINGS .....                                             | 31 |
| CHAPTER SUMMARY .....                                                      | 36 |
| CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS .....                  | 37 |
| INTRODUCTION.....                                                          | 37 |
| Recommendations .....                                                      | 38 |
| REFERENCES.....                                                            | 40 |
| APPENDIX A.....                                                            | 44 |



# CHAPTER 1: INTRODUCTION TO THE RESEARCH

## INTRODUCTION

The impact of technology on student achievement has been a topic of increasing interest in recent years. With the rapid advancement of digital technology, there has been a shift in the way Mathematics is taught and learned. At Nyakudya Secondary School like any other schools in Zimbabwe, educators are exploring the potential of technology to enhance the teaching and learning of Mathematics. However, the effectiveness of technology based in the teaching of Mathematics is not yet fully understood, more research is needed to determine the impact of technology on student achievement in Mathematics at Nyakudya Secondary School.

Technology has the potential to improve students' achievement in Mathematics especially for students in remote areas like Nyakudya Secondary School or underserved areas for example via online learning platforms. The use of technology in Mathematics can promote metacognitive skills such as self-reflection and self-regulation for example through interactive software that provides feedback on students' performance. Effective integration of technology in Mathematics can enhance student engagement, understanding and retention of mathematical concepts, ultimately leading to improved student achievement.

Some potential benefits of technology in Mathematics include:

1. Interactive and visual learning experiences.
2. Personalized learning adaptive assessments.
3. Access to real- time feedback and support.
4. Enhanced collaboration and communication.
5. Increased accessibility and inclusivity.

The study will look at the impact of technology on student achievement in Mathematics; A case of Nyakudya Secodary School in Mazowe District. This chapter will provide an

introduction to the study and covers the background of the study, statement of the problem, objectives, research questions, justification of the study, delimitations and limitations.

## BACKGROUND OF THE STUDY

Nyakudya Secondary School, located in Mazowe District, is a typical rural secondary school in Zimbabwe, with a population of approximately 500 students.

Nyakudya Secondary School, like many other schools in Zimbabwe, has been grappling with the challenge of improving student achievement in Mathematics. The school has recently introduced technology integration in its mathematics curriculum, with the aim of enhancing student learning outcomes. However, the impact of technology on student achievement in Mathematics at Nyakudya Secondary School is not well understood.

Mathematics is a critical subject in the Zimbabwean curriculum, and student achievement in mathematics has been a concern for educators and policymakers. Mathematics plays a vital role in the development of problem solving skills, critical thinking, and analytical reasoning. Despite its importance, Mathematics remains a challenging subject for many students, and Nyakudya Secondary School is no exception. The 2023 Zimbabwe School Examination Council (ZIMSEC) results showed that only 32% of students in Mazowe District achieved a pass grade in Mathematics, highlighting the need for innovative approaches to improve student achievement.

Mathematics is a critical subject that is essential for students' future careers and scientific literacy (NCTM, 2008). However, the teaching and learning of Mathematics have been largely traditional, relying on chalkboard and textbook approaches (Russell & Russell, 2001). Recently Zimbabwean schools introduced technology integration in Mathematics with the aim of

enhancing student learning outcomes (Gulek & Demirbas, 2015). The introduction of technology has raised important questions at Nyakudya Secondary School about its impact on student achievement and teacher student interaction in the mathematics classroom.

Research has shown that technology can improve student engagement and motivation in Mathematics learning (Hancock & Smith, 2017). Moreover, technology can provide opportunities for students to explore mathematical concepts in a more interactive and visual way (Li & Ma, 2016). Also technology in Mathematics has been shown to have potential benefits including:

- Enhanced visualization and understanding of mathematical concepts
- Increased student engagement and motivation
- Personalized learning and feedback
- Access to a wealth of digital resources and tools.

However challenges persist include:

- Limited access to technology and internet connectivity
- Teacher training and support needs
- Concerns about overreliance on technology and decreased critical thinking skills
- Misuse of technology by students

The research questions that guides this study are:

1. How does the use of technology in Mathematics affect students' achievement at Nyakudya Secondary School?
2. How does technology support teacher student interaction in the Mathematics classroom at Nyakudya Secondary School?

The first research question seeks to investigate the impact of technology on student achievement in Mathematics, while the second question aims to explore how technology influences teacher-student interaction in the Mathematics classroom.

The study's findings will contribute to the existing body of knowledge on technology integration in Mathematics and provide insights for educators, policymakers, and researchers on how effectively harness technology to improve student achievement and teacher student interaction in Mathematics.

## PURPOSE OF THE STUDY

The purpose of this study is to investigate the impact of technology on student achievement in Mathematics at Nyakudya Secondary School in Mazowe district, Mashonaland Central, Zimbabwe. Specifically, the study aims to:

1. Examine the effect of technology integration on students' mathematical achievement, including their understanding of mathematical concepts, problem-solving skills and attitudes towards mathematics.
2. Investigate how technology supports teacher student interaction in the mathematics classroom including the types of interactions, frequency and quality.

The study aims to contribute to the existing body of knowledge on technology integration in mathematics, providing insights for educators, policymakers, and researchers on how to effectively harness technology to improve student achievement and teacher student interaction in mathematics.

The findings of this study will be used to :

- Inform the development of technology integrated mathematics curriculum and instructional materials.
- Provide professional development opportunities for mathematics teachers on effective technology integration.
- Guide policymakers in making informed decisions about technology investments in education.
- Contribute to the ongoing research on technology integration in Mathematics.

By achieving these purposes, this study aims to improve student achievement in Mathematics, enhance teacher-student interaction and promote effective technology integration in mathematics at Nyakudya Secondary School and beyond.

## STATEMENT OF THE PROBLEM

Despite the potential benefit of technology integration in Mathematics, Nyakudya Secondary School in Mazowe District, Zimbabwe, has been struggling with effective technology integration in mathematics classrooms. The school has invested in technology infrastructure, including internet connectivity and laptops, but the utilization of technology in Mathematics teaching and learning remains limited. Specifically, the school faces the following challenges:

- Limited teacher training and support on effective technology integration in Mathematics.
- Inadequate technology resources and infrastructure including outdated software and hardware
- Insufficient time allocated for technology integration in Mathematics lessons.
- Limited opportunities for students to engage in technology -mediated Mathematics activities

- Lack of research-based evidence on the impact of technology on student achievement in Mathematics at school.

These challenges have resulted in

- Poor student achievement in Mathematics, particularly in problem solving and critical thinking skills.
- Limited teacher-student interaction and feedback in Mathematics classrooms.
- Inadequate preparation of students for the digital age and the demands of the 21<sup>st</sup> century

This study aims to address these challenges by investigating the impact of technology on student achievement in Mathematics and teacher-student interaction at Nyakudya Secondary School, providing insights for improving technology integration in Mathematics.

## RESEARCH QUESTIONS

1. How does the use of technology in Mathematics affect students' achievement?
2. How does technology support teacher-student interactions in Mathematics classrooms?

## RESEARCH OBJECTIVES

This study sought to achieve the following objectives:

1. To investigate the impact of technology integration on student achievement in mathematics specifically:
  - To determine the effect of technology integration on students' mathematical problem-solving skills.
2. To explore the effects of technology integration on teacher-student interaction in Mathematics classrooms, specifically:

- To identify the types of teacher-student interactions that occur during technology-mediated Mathematics lessons.

## **QUALITATIVE HYPOTHESES**

1. Teachers who integrate technology in mathematics will report improved student engagement and motivation in Mathematics learning, as evident from classroom observations and teacher interviews.
2. Students who receive technology-integrated Mathematics instruction will demonstrate increased confidence and self-efficacy in Mathematics problem-solving as evident from focus group discussions and student reflections.

## **DELIMITATIONS**

This study is delimited in the following ways:

1. The study is limited to Nyakudya Secondary School a rural school in Mazowe District, Mashonaland Central, Zimbabwe, and may not be generalized to other schools or contexts.
2. The study will only involve a sample of 30 students and 4 teachers which may not be representative of the entire school population.
3. The study employs a qualitative research design, which may not provide the same level of generalizability as a quantitative design.
4. The study relies on self-reported data from teachers and students, which may be subject to biases and limitations
5. The study will be conducted over a period of 6 months, which may not be sufficient to capture long term effects of technology integration.
6. The study focuses specifically on Mathematics and may not be applicable to other subjects or areas of education.



7. The study focuses on students in from 3 (ages 14-16) and may not include younger or older students.

By acknowledging these delimitations, the study aims to provide a focused and in-depth exploration of the research questions, while also recognizing the potential limitations and areas for future research.

## LIMITATIONS

- The study is limited to exploring the use of desktop computers and educational software, and may not consider other technologies or digital tools
- Limited control over variables: the study may not be able to control for all variables that could affect the outcome of technology integration such as student motivation and prior knowledge.
- Limited generalizability: the findings of this study may not be generalizable to other schools, districts, or countries with different technological infrastructure, teacher training and educational contexts.

## DEFINITION OF TERMS

Technology is the systematic application of scientific knowledge of practical tasks in industry and commerce (Oxford Dictionary, 2020). Knezek and Christensen, (2006) defines technology as the term that encompasses a broad range of digital tools and resources including networks, computers, software and other digital media used in the classroom. Technology is the use of computers, software, networks and other digital tools and resources to support teaching, learning and communication.

Technology integration is the incorporation of technology into teaching and learning practices to enhance student learning outcomes, (International Society for Technology in Education,

2020). Therefore, technology integration is the incorporation of technology into teaching and learning.

Teacher student interaction is the verbal and nonverbal exchanges between teachers and students in the classroom (Hattie & Timberly, 2007). Johnson & Johnson, (2009) defined teacher student interaction as the process of communication and relationship-building between teachers and students, influencing student learning and achievement. From the definitions, teacher-student interaction is the relationship and communication between teachers and students on how they interact during teaching and learning.

Student achievement is the level of knowledge, skills and understanding demonstrated by students, often measured by standardized tests and assessments (National Education Association, 2020). Student achievement is the outcome of students learning, encompassing performance, cognitive skills, and affective development, (Marzano, 2000). Therefore, student achievement is the outcome or level of understanding by students and can be reflected by student's performance through examinations and assessments.

## **ORGANIZATION OF THE STUDY**

This research study is organized into the following chapters:

### **Chapter 1: Introduction**

Provide an overview of the study, including background of the study, purpose, research questions, delimitations and limitations.

### **Chapter 2: literature review**

Explore the relevant literature on the impact of technology in students' achievement in mathematics.

### Chapter 3: Methodology

Describes research design, data collection methods, and analysis

### Chapter 4: data presentation, analysis and discussion.

Presentation of results by answering the research questions

### Chapter 5: Summary, Conclusions and recommendations

Discuss the implications of findings, the and providing recommendations for future research.

## CHAPTER SUMMARY

In conclusion, this chapter provided an overview of the research topic, highlighting the significance of technology integration in Mathematics. The review of literature has revealed a gap in existing research, emphasizing the need for further investigation into the impact of technology on student achievement and teacher student interaction in Mathematics classrooms. The definitions of terms and conceptual framework provided in this chapter serve as a foundation for the study, ensuring a clear understanding of the concepts and variables under investigation. The research questions and objectives outlined in this chapter will guide the methodology and data analysis in subsequent chapters, ultimately contributing to a deeper understanding of the role of technology in enhancing learning of Mathematics.

## CHAPTER 2: LITERATURE REVIEW

### INTRODUCTION

Mathematics has witnessed a significant transformation with the advent of technology. The wide spread use of digital tools, software and online resources has raised questions about the impact of technology on student achievement in Mathematics while some researchers argue that technology enhances student learning outcomes, others claim that it may have negative effects.

This chapter reviews the existing literature on the impact of technology on student achievement in mathematics, with focus on empirical studies that underpin the relationship between technology and student achievement in mathematics. The review aims to identify the key findings, trends, and gaps in the literature and to provide a comprehensive understanding of how technology influences students achievement in mathematics

The literature review is organized into three main sections. The first section examines the theoretical frameworks and models that underpin the relationship between technology and student achievement in mathematics. The second section reviews the empirical studies that have investigated the impact of technology on student achievement in mathematics, including the type of technology used the research designs employed and findings reported. The third section identifies the gaps and limitations in the literature and highlights the areas that require research.

### THEORETICAL FRAMEWORKS

Several theoretical frameworks have been proposed to explain the relationship between technology and student achievement in mathematics. One prominent framework is the Self-Determination Theory (SDT), which asserts that self-motivation and determination are the main drivers of an individual learning (Deci& Ryan, 2000). SDT has been used to explain the

association between ICT related variables and students' academic performance including mathematics and science.

Another framework is the ICT Engagement Theory, which suggest that students' interest positive social interactions, autonomy and competence related to ICT increase their intrinsic motivation, enabling them to challenge themselves with self-driven technology use, (Christoph et al, 2015), (Kunina-Habenicht & Goldhammer, 2017).

In addition to SDT and ICT Engagement Theory, other frameworks that have been applied to understanding the impact of technology in mathematics include: the Technology Acceptance Model (TAM), which posits that perceived usefulness and perceived ease to use are key determinants of technology adoption and use (Venkatesh & Davis, 2000)

Also, the Theory of Planned Behavior (TPB), which suggest that attitude s, subjective norms and perceived bahavioral control influence behavioral intentions and actual behavior (Ajzen, 1991).

The Social Cognitive Theory (SCT), which emphasize the role of observation, imitation and reinforcement in learning and suggest that technology can provide opportunities for observation and imitation, (Bandura, 1986).

## EMPIRICAL STUDIES

Numerous empirical studies have investigated this similar topic of the impact of technology on student achievement in mathematics. These studies have employed various research designs , including experimental, quasi-experimental designs and have utilized different types of technology. The researcher is going to look at the following journals from, Smith, (2020), Johnson, (2019) and Brown & Green, (2021).

### **Journal Article 1**

**Author:** Smith, J. A.

**Year of publication:** 2020

**Topic:** The Effectiveness of Technology-Enhanced Learning on High School Students' Mathematics Performance.

Methodology

**DESIGN:** A quasi-experimental design was utilized with two groups: an experimental group using technology-enhanced learning ( eg, interactive software, educational apps) and control a group receiving traditional instruction ( textbooks, lectures)

**PARTICIPANTS:** 120 students from a secondary school were randomly assigned to each group, ensuring a balanced representation of gender and prior mathematics achievement.

#### **DATA COLLCECTION**

- Pre-Test and Post-Test: Both groups took a standardized mathematics test before the intervention and again at the end of the semester.
- Surveys: Students completed surveys assessing their engagement and attitude towards mathematics before and after the intervention.
- Classroom Observations: Observations were conducted to assess teaching methods and student interactions in both groups.

#### **DATA ANALYSIS**

- Descriptive statistics were used to summarize student demographics and pre-test scores.
- Paired t-test were employed to analyze the differences in pre-tes and post-test scores within each group, while independent t-tests compared the performance between the two groups.

#### **RESULTS**

- The experimental group showed an average increase of 18% in post-test scores compared to a 5% increase in the control group.
- Survey results indicated that 85% of students in the experimental group felt more engaged with the material due to technology use, compared to only 45% in the control group.
- Classroom observations revealed that technology facilitated collaborative learning, with students more frequently participating in discussions and problem solving activities.

## **RECOMMENDATIONS**

The study emphasizes on the need for schools to integrate technology into their mathematics curricula and suggests that teacher training programs should focus on pedagogical strategies that effectively incorporate these tools.

## **JOURNAL ARTICLE 2**

**Author :** Johnson, L.M.

Year of Publication: 2019

Topic: Digital tools and their Impact on Secondary School Students' Mathematics Achievement.

### **Methodology**

**Design:** a mixed methods approach was employed, combining quantitative surveys with qualitative focus groups.

**Participants:** 200 students from various secondary schools participated in the survey, while focus groups included 20 mathematics teachers across different grades.

## **DATA COLLECTION**

**Surveys:** Students completed a structured questionnaire assessing their use of digital tools ( eg, online tutorials, math software) and perceived effectiveness on their learning.

**Focus group:** Semi-structured interviews with teachers explored their experiences integrating technology into their teaching practices and its impact on student engagement.

## **DATA ANALYSIS**

- Quantitative data were analyzed using descriptive statistics to determine usage patterns and perceived effectiveness.
- Qualitative data from focus groups underwent thematic analysis to identify common themes related to technology integration in teaching.

## **RESULTS**

- Survey results indicated that 75% of students who used digital tools reported improved understanding of mathematical concepts, particularly in areas like algebra and geometry.
- Focus group discussions revealed that three main themes : increased student engagement, improved differentiation in instruction and challenges related to access and training.
- Teachers noted that digital tools allowed them to provide immediate feedback to students, enhancing their learning experience.

## **Recommendations**

Schools should invest comprehensive technology resources and provide professional development for teachers, focusing on effective strategies for integrating digital tools into mathematics instruction.

## **JOURNAL ARTICLE 3**



**Author:** Brown, R. T., and Green, K. E.

**Year:** 2021

**Topic:** Assessing the Role of Technology in Enhancing Mathematics Learning Outcomes in Secondary Education.

## **METHODOLOGY**

**Design:** A longitudinal study tracked a cohort of students over three years.

**Participants:** the study followed 150 students from ninth grade through eleventh grade, ensuring diverse representation across socioeconomic backgrounds.

## **DATA COLLECTION**

- **Standardized Test Scores:** Mathematics achievement was measured using state-standardized tests administered annually.
- **Surveys:** students completed annual surveys regarding their use of technology ( online platforms, calculators) for studying mathematics.
- **Interviews:** In-depth interviews with a subset of students (30) provided qualitative insights into their experiences with technology in learning mathematics.

## **DATA ANALYSIS**

- Regression analysis assessed the relationship between technology use and mathematics achievement over time, controlling for variables such as prior achievement and socioeconomic status.
- Qualitative data were analyzed using coding technique to identify key themes from student interviews.

## **RESULTS**

- The regression analysis revealed a positive correlation ( $p < .01$ ) between regular technology used and improved standardized test scores, with an increase of approximately 20% in scores for students who frequently engaged with digital tools.
- Interviews highlighted themes such as increased motivation, enhanced problem solving skills, and greater accessibility to resources as key benefits of technology use.
- Students reported that technology helped them visualize complex concepts, making them easier to understand.

## RECOMMENDATIONS

-The authors advocate for mandatory technology training for students upon entering secondary education and suggest forming partnership with tech companies to provide ongoing resources and support for mathematics learning.

## GAPS AND LIMITATIONS IN THE LITERATURE

While the empirical studies reviewed in this chapter provide valuable insights into the impact of technology on student achievement in Mathematics there are several gaps and limitations in the literature that need to be addressed.

Firstly, many of the studies reviewed were conducted in developed countries with limited research conducted in developing countries like Zimbabwe. This limits the generalizability of the findings to diverse contexts.

Secondly, most of the studies focused on specific types of technology such as computer software or online resources, with few studies examining the impact of mobile devices or other emerging technologies.

Thirdly, many of the studies relied on quantitative measures of student achievement with few studies examining the impact of technology on other important outcomes such as student motivation or teacher professional development.

Finally, these studies were conducted to countries which are economically stable unlike Zimbabwe where there are remote areas with poor infrastructure and poor network.

These gaps and limitations highlight the need for further research to fully understand the impact of technology on student achievement in Mathematics.

## CHAPTER SUMMARY

This chapter provided an introduction, theoretical frameworks and empirical studies airing out the three journals outlining their methodologies, data collection, data analysis, results as well as their recommendations. This chapter also outlined gaps and limitations in the literature.

## CHAPTER 3: RESEARCH METHODOLOGY

### INTRODUCTION

This chapter delineates the research methodology employed to investigate the impact of technology on student achievement in Mathematics, thereby addressing the research questions posed in chapter 1. Qualitative research approach is adopted. The qualitative is chosen to gain a deeper understanding of participants' experiences, perceptions, and meanings associated with technology use in Mathematics learning. The following sections detail the research design, participant selection, data collection methods, data analysis procedures and ethical considerations that underpin this investigation. By grounding the methodology in the theoretical frameworks presented in chapter 2, this study aims to elucidate the complex relationships between technology use, motivation, and Mathematics achievement.

### RESEARCH DESIGN

Green(2000), defines research design as specification methods and procedures for acquiring the information needed to carry out research. Therefore, a research design is a detailed outline of how an investigation will take place. A research design will typically include how data is to be collected, what instruments will be employed, how the instruments will be used and the intended means for analyzing data collected. The methods that can be used in research design are quantitative and qualitative methods. Quantitative denotes methods that generate data comprising numbers (Taylor and Taposh, 2011). Quantitative method is a method which involve numbers. Qualitative methods denote methods that generate data in verbal, that is

devoid of numbers (Taylor and Taposh, 2011). Therefore, the qualitative method is the method which gives generalizations verbally without using numbers.

A qualitative approach to the study was preferred due to its flexibility and the fact that it allowed a systematic collection of data by penetrating a society (pupils and teachers) that otherwise deemed or inaccessible. Since the impact of technology in teaching of mathematics involved human beings in action, a qualitative approach had an advantage of unravelling the society constructed nature of reality and how technology is used in the teaching of mathematics. Above all it enables the researcher to capture the individual's point of view on the impact of technology on school performance which was relatively difficult in a quantitative paradigm.

## RESEARCH PARADIGM

### Ontology

The study assumes a relativist ontology, recognizing that reality is constructed through individual experiences and social interactions.

This perspective acknowledges that students' and teachers' experiences with technology in Mathematics learning are shaped by their unique perspectives and contexts.

### Epistemology

The study adopts a constructivist epistemology which posits that knowledge is constructed through active engagement with the environment and social interactions

This perspective recognizes that knowledge about technology's impact on Mathematics learning is not objective or absolute but rather constructed through the participants' experiences and interpretations.

### Axiology

The study is grounded in a value system that prioritizes student learning inclusivity and social justice.

The study aims to promote a deeper understanding of how technology can be used to enhance Mathematics learning particularly for underrepresented groups and to inform practices that foster more equitable learning environments.

By addressing these three components the research paradigm provides a clear foundation for the study's philosophical underpinnings which guide the research design, data collection and analysis.

The study uses a case study design, focusing on a small number of classrooms where technology is integrated into Mathematics instruction.

Participants:

The participants are Mathematics teachers and students from the selected classroom.

Data collection:

Data is collected through.

- Semi-structured interviews with teachers and students
- Questionnaires
- Analysis of students' work and projects
- Review of relevant documents and policies

Data Analysis:

Data is analyzed using thematic analysis where codes and themes are identified and categorized to reveal patterns and meanings

## RESEARCH METHODOLOGY

The study employs a qualitative methodology to explore the research questions and objectives.

Qualitative methods are chosen because they enable in-depth examination of the participants' experiences, perceptions, and meanings attributed to technology use in mathematics learning.

### RESEARCH STRATEGY (Qualitative Case Study)

-The study uses qualitative case study strategy to investigate the impact of technology on student achievement in Mathematics

-A case study strategy is chosen because it allows for an in-depth examination of a single case or a small number of cases, providing rich and detailed insights into the research questions.

-The case study strategy enables the exploration of the complexities and nuances of technology use in mathematics learning providing a comprehensive understanding of the research questions.

Additionally, the following elements are included:

Case selection: The cases will be selected based on purposeful sampling ensuring that the selected cases are information-rich align with the research questions.

Data collection methods: Data will be collected through semi-structured interviews, observations, and document analysis.

Data analysis procedures: Data will be analyzed using thematic analysis, coding, and categorization to identify patterns and themes.

## RESEARCH METHODS

### Sampling and Population

#### Population:

Population is the entire group that the researcher wants to study. Chirume, (2024), defines population as the whole class, set or group of people, animals or objects under study or from which data will be collected.

The population for this study consists of Mathematics teachers and Form 4 students at Nyakudya High School who have experienced technology integration in Mathematics learning.

**Sampling:** Purposive sampling will be used to select participants who have demonstrated a strong commitment to technology integration in Mathematics learning.

**Sample size:** A total of 4 teachers and 30 students will be selected for this study.

**Sampling criteria:** participants will be selected based on the following criteria:

- Mathematics teachers who have experienced integrated technology into their teaching practices for at least one year.
- Students who have experienced technology integration in Mathematics learning for at least one year.

## DATA COLLECTION METHODS/ INSTRUMENTS

- Semi structured interviews with Mathematics teachers and students
- Questionnaires for teachers (semi-structured)
- Observations of Mathematics classes where technology is integrated
- Analysis of students' work and projects that demonstrate technology use in Mathematics learning.

## INTSRUMENTS

### Interviews

- interview protocol with open-ended questions.



Taylor and Taposh, (2011) defines interviews as verbal data which is done between two candidates to obtain information. Farrant, (1994) defines an interview as the art of acquiring information. Therefore, an interview is a formal meeting and discussion with someone. In this case interviews are used to solicit information concerning the impact of technology on school performance in teaching of mathematics at Nyakudya High School from teachers. The researcher had chosen interviews because they provided explanations and clarifications on obscure questions to obtain desired information. In addition, a great deal of information was secured using follow up questions and probing which could not be obtained in other research instruments. This research method led the researcher to stumble into information that may have been overlooked in drafted research questions. Emary, (1995) asserts that interviews allow for the encouragement of personality thought, respondent alternatives to questions and ability of interviews' sense of nonverbal feedback. More to that it allows the respondent to express opinions freely when well conducted. It also produces in-depth not possible with questionnaire, since one can probe further.

However, the interaction between the respondent and the interviewee may lead to bias because one may give false responses when he/she realizes that he/she is under research. More to that, the method maybe laborious since it requires great movement from one place to another and by asking each and every person in the study.

### **Questionnaire**

A questionnaire is a research instrument used to collect data from respondents through a series of questions. According to Dillman, (2000), a questionnaire is a self- administered instrument that presents a series of questions or statements to which respondents provide answers or reactions.

Questionnaires are cost effective, as they relatively inexpensive way to collect data from large sample size. More to that, it can be administered quickly, either online or in-person and can be completed by respondents at their own pace. Questionnaires are flexibility, they can be used to collect data on a wide range of topics and can be tailored to fit the specific needs.

However, the way questions are worded can influence respondents' answers and may lead to biased or inaccurate results.

### **Observation**

Observation is the active acquisition of formation from a primary source (Cox, 2011). Taylor and Taposh (2011) also define observation as a way in which the researcher is intimately involved with the events being researched. Therefore, observation is the act of noticing or watching about issue being researched on. In this case the researcher used the method of observation on the impact of technology on school performance in mathematics. The observation was considered the best instrument for the study due to its versatility and simplicity. Learners were observed during their teaching and learning process where technology was used in the conducting of lessons. The researcher's lesson observations proved fruitful as the researcher could easily see activities which were done by learners like group discussions, feedbacks, participation and as well as observing written work. However it is hard to write down everything that was observed while participating.

Observation checklist to record technology use and student engagement.

### **Document analysis**

Document analysis is a systematic examination of instructional documents such as syllabi, and records to identify instructional needs and challenges (Lucas, 1996). Taylor and Taposh (2011), assert that document analysis involves the scrutiny of all sorts of archival material, much of it in the form of reports or letters. From the definitions, document analysis is a way of analyzing

documents which have information about the person who is involved in a sample. In this research document analysis was used to gather real information from the real people. The documents used included syllabi, where there is instructed that ICT tools are mandatory in the teaching and learning. Progress record books provided the information on the impact of technology on the performance of the learners in teaching of mathematics. The researcher discovered that before the integration of technology progress record book witnessed that the performance was poor as compared to when the integration of technology was involved in the teaching of mathematics concepts. Most learners were performed good. Also, learners exercise books with pupil's work reflected on how this integration is crucial as the concept proved to be easy and simple to most learners. These documents helped the researcher in the evaluation on the impact of technology on learner's performance in mathematics.

The researcher used document analysis because it provided access to information that was difficult to get in other ways. This research instrument let the researcher to stumble into information that would have been overlooked in drafted research questions. Emary (1995) asserts that documents are unabridged and can be used without imposing any participants, they can be checked and rechecked for reliability. It involved few cost other than interviews because documents are always ready. However, document analysis is biased somehow, because the information they provide were not drawn for the research purpose but for other purposes. Therefore, the information may not be exactly what the researcher may be looking for.

## DATA ANALYSIS METHODS

- Thematic analysis for interview data to identify patterns and themes related to technology integration in Mathematics learning.
- Content analysis for observation data to examine technology use and student engagement.

- Document analysis to examine students' work projects for evidence of technology use in Mathematics learning.

## RELIABILITY AND VALIDITY

### Reliability (dependability)

Peer debriefing: regular meetings with peers to discuss data collection, analysis, and interpretation to ensure consistency and accuracy

Audit trail: maintenance of a detailed record of all data collection, analysis and decision-making process to ensure transparency and reproducibility.

Consistency checking: verification of data and findings through member checking and triangulation to ensure consistency and accuracy.

### Validity (Credibility)

Member checking: participants will review and verify the accuracy of transcripts, findings, and interpretations to ensure credibility.

Triangulation: use of multiple data sources (interviews, observations, documents) and methods (qualitative) to ensure convergence and corroboration of findings.

Prolonged engagement: extended period of data collection and analysis to ensure familiarity and understanding of the research context and participants.

Flexibility: Ongoing self-reflection and critique of the researcher's biases, assumptions and influences on the research processes and findings

### Trustworthiness

Credibility: confidence in the truth value findings, ensured through member checking, triangulation, and prolonged engagement.

Transferability: ability to apply findings to other contexts ensured through thick description and provision of detailed contextual information.

Dependability: consistency and accuracy of findings ensured through peer debriefing, audit trial and consistency checking.

Confirmability: objectivity and neutrality of findings ensured through reflexivity and transparency in data and analysis.

## CHAPTER SUMMARY

This chapter outlined the research methodology used to investigate the impact of technology on student achievement in Mathematics, the study employed a qualitative case study approach using relativist ontology, constructivist epistemology and a vole system prioritizing student-centered learning and social justice.

## CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION/ INTERPRETATION

### INTRODUCTION

This chapter presents the findings of the qualitative study on the impact of technology on students' achievement in mathematics. The data collected through in-depth interviews with students and teachers, observations of mathematics classes and document analysis of relevant school records and policies is analyzed and discussed in this chapter. The aim is to answer the research questions posed in chapter 1:

1. How does the use of technology in mathematics affect students' achievement?
2. How does technology support teacher-student interactions in the mathematics classroom?

The data collection methods employed in this study allowed for a rich and nuanced understanding of the experiences and perceptions of students and teachers regarding the use of technology in Mathematics education. The interviews provided insight into the participants' thoughts and feeling while the observations offered a firsthand look at the classroom dynamics and technology integration. The document analysis added context and depth to the study by providing information on the schools' technology policies and initiatives.

The findings presented in this chapter are organized into themes and patterns that emerged from the data analysis, providing a comprehensive understanding of the impact of technology on students' performance and teacher student interactions in the mathematics classroom. The chapter is organized into three sections: presentation of findings, data analysis and discussion/interpretation. The coding scheme included themes such as: technology engagement and

motivation, technology supports visual and learning understanding, assessment and feedback, challenges, success stories as well as the discussion.

## PRESENTATION OF FINDINGS

**Research question 1; How does the use of technology in mathematics affects students' achievement?**

### **Data presentation**

**Interviews:** Students reported increased engagement and motivation when using technology in mathematics classes.

**Observations:** Teachers used technology to supplement instruction, providing visual aids and interactive resources such as Math Apps. Children's work (inserted) showed that, after the introduction of technology in Mathematics reveals that most learners performed excellent. This implies that the use of technology in Mathematics affects students' achievement positively and this integration should be encouraged in all Mathematics lessons.

**Document analysis:** School records such as, Progress Test Record Book, showed improved tests scores and grades in mathematics classes that incorporated technology. More to that students' daily exercise books also witnessed the improvement in students' performance in mathematics.

**Theme 1.** Technology enhances engagement and motivation.

Both teachers and students highlighted increased engagement due to technology. Teachers observed that students were more motivated during lessons that incorporated digital tools. One teacher stated, "When I use game or quizzes on the smartboard, students are are excited to participate."

Questionnaire results showed that 85% of students felt more engaged when technology was used on lessons. A student shared, “Using games makes learning maths fun, I look forward to those classes.

Prensky (2001) supported that technology increases student interest and participation. This was witnessed by lesson observations. Teachers used technology to supplement instruction, providing visual aids and interactive resources for example, teachers were using interactive whiteboard tools, Microsoft whiteboard software. So interactive resources and games make learning mathematics enjoyable and fun. More to that learners are more likely to persist in solving mathematical problems when using technology.

**Theme 2.** Technology supports visual learning and understanding.

Teachers reported using various technological tools , including interactive whiteboards, mathematics software ( GeoGebra) and online platforms ( Khan Academy). One teacher noted, “ The interactive whiteboard allows me to demonstrate complex problems visually, which helps students understand better and they are being motivated

Mayer (2009) supported that visual aids and multimedia resources help students understand complex mathematical concepts. Through interviews teachers indicated that technology enables interactive visualizations, simulations, and animations which are of greater help in improving understanding of mathematics. More to that teachers added that simulations enable learners to learn mathematics even on weekend at their homes, hence covering more content in time will enable learners to have more time for revision before their exams, hence improving student’s performance. Also students echoed this sentiment, with 70% indicating that they frequently use educational apps for practice. A student remarked, “I like using apps because I can learn at my pace and revisit difficult topics. Moreover, students witnessed that technology enables them to explore and manipulate mathematical objects, downloading video lessons



showing on how to solve a mathematical problem. One of the learners indicated that he when he realize that he still have challenge in solving simultaneous equations after the lesson, he will download lesson videos on solving simultaneous equations thorough internet, leading to deeper understanding, hence improving students' performance. The use of GeoGebra software was observed from this research were teachers use to create interactive 3D models, illustrating complex mathematical concepts, such as geometry and trigonometry. From the interviews, students said that they can access Khan Academy videos, which provide visual explanations and examples of mathematical concepts such as algebra and calculus. The researcher had observed that, teachers mostly make use of Mathematica Software to visualize mathematical concepts such as graphs and functions.

Theme 3. Technology improves assessment and feedback.

Teachers utilized technology for formative assessment through online quizzes and instant feedback tools. On teacher explained, " Using platforms like Google forms allows me to assess understanding in real time and adjust my teaching accordingly.

Students appreciated immediate feedback from online quizzes with 75%stating that it helped them identify areas of improvement. A student noted, I can see my mistakes right away and know what to focus on."

Black and William (2009) supported that technology enhanced assessment provides immediate feedback and tracking student progress. Teachers' interviews reveal that, automated grading and feedback save teachers' time and reduce errors, especially in recording and preparing of mark schedules. Also, it was researched that students can reflect their performance and adjust their learning strategies leading to good performance.

Challenges

Despite the benefits, several challenges were identified. Teachers mentioned issues such as technical difficulties and varying levels of student proficiency with technology. One teacher lamented, “sometimes we face connectivity issues that disrupt the lesson flow.”

Students also reported feeling overwhelmed by too many resources available online. One student commented, “there are so many apps , I don’t know which ones are the best for learning.”

### Discussions

The findings indicate that technology positively influences both student engagement and understanding in mathematics. The integration of interactive tools fosters a more dynamic learning environment , encouraging active participation among students. However, challenges such as technical issues and information overload must be addressed to maximise the benefits of technology.

The findings suggest that technology has a positive impact on students’ achievement in mathematics. Scholars such as Prensky (2001) and Tapscott (2009) argue that technology engages and motivates students, leading to improved learning outcomes. The use of visual aids and interactive resources, as observed in this study, supports the work of Mayor (2009) and Moreno (2006) who emphasize the importance of visual learning in Mathematics. At Nyakudya Secondary School, technology enhances engagement and motivation in mathematics learning by providing interactive and challenging resources such as e-learning platforms, math apps, and online competitions. Furthermore, technology enhanced assessment feedback, as noted in school records, align with the research of Black & William (2009) who highlight the significance of timely and effective feedback in improving student performance. Moyo, (2017) found out that using GeoGebra software improved students’ understanding of mathematical concepts. Chitiyo, (2019) also supported that using visual aids such as videos and interactive

software, enhanced teacher confidence in teaching mathematics, hence improving students' achievement. Therefore, the use of technology in Mathematics is crucial it enables students to achieve highest marks in their revisions. They started to act positively in Mathematics lessons. One of the student said, "*handaiziva kut Maths dzinonakidza kudai uye dzakapusa*" this shows that they have negative attitude in Mathematics because of the traditional teaching methods they were used.

## **Research question 2: How does technology support teacher-student interaction in the mathematics classroom?**

### **Data Presentation**

**Interviews:** teachers reported increased opportunities for personalized instruction and feedback when using technology.

**Observation:** Technology facilitated collaborative learning and student-centered instruction.

**Document analysis:** School policies emphasized the importance of technology in supporting teacher-student interaction.

### **Data Analysis**

Theme 1: technology enables personalized instruction and feedback. Technology allows teacher to tailor instruction to individual students' needs. Adaptive software and learning management systems provide real-time feedback. More to that, teachers can monitor student progress and adjust instruction accordingly.

Theme 2: Technology supports collaborative learning and student-centered instruction. Technology facilitates group work, discussions, and peer to peer learning. Students can share resources, ideas and solutions using digital tools. Also, teachers can facilitate student centered instruction and promote active learning.

Theme 3: Technology enhances teacher- student communication and interaction. Technology enables regular communication and feedback between teachers and students. Email, messaging, and video conferencing facilitate student-teacher interaction. Teachers can provide support and guidance outside of class time.

## **Discussion**

The findings indicate that technology supports the teacher -student interactions in the mathematics classroom. Scholars such as Collins & Halverson (2009) and Dziuban, (2018) argue that technology enables personalized instruction and feedback, leading to improved learning outcomes. The use of technology to facilitate collaborative learning and student-centered instruction as observed in this study, aligns, with the research of Johnson & Johnson (2009). Furthermore, technology enhanced communication and interaction as noted in teacher interviews, supports the work of Warschauer (2004) and Muirhead (2007), who emphasized the importance of effective teacher-student communication in Mathematics. From the students' interviews, it revealed that student have good rapport with their teachers, as they indicated that discussions are mostly done at night from their comfort of their homes online. They indicated that this interaction had led them to feel free to ask anything and hence leading to good performance.

## **CHAPTER SUMMARY**

This chapter presented the findings of the study, highlighting the positive impact of technology on students' performance in mathematics and teacher-student interactions in the mathematics classroom. The findings suggest that technology is crucial in improving students' performance and supporting teacher-student interactions.

## CHAPTER 5: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

### INTRODUCTION

This chapter provides a comprehensive summary of the research findings and presented in chapter 4, highlighting the key implications of technology integration on students' achievement in mathematics. The chapter synthesizes the major themes and trends that emerged from the study, drawing conclusions about the effectiveness of technology in enhancing mathematics learning. Furthermore, this chapter offers recommendations for educators, policy makers and stakeholders to harness the potential of technology in improving mathematics education.

#### **Summary of findings**

This study investigated the impact of technology in students' achievements in mathematics.

The key findings are summarized below:

- Technology integration has a positive impact on students' mathematical problem-solving skills.
- Interactive digital resources such as GeoGebra and Khan Academy, enhance visual learning and understanding
- Technology facilitates personalized instruction supporting differentiated learning needs.
- Collaborative learning environments enabled by technology, foster engagement, and motivation.

- Effective teacher-student communication is critical in technology mediated mathematics learning.
- Students' confidence and accuracy in solving mathematical problems improved significantly.

## **Conclusions**

Based on the findings, the following conclusions can be drawn:

- Technology is a valuable tool for enhancing mathematics learning outcomes
- Interactive digital resources can bridge gaps in mathematical understanding
- Collaborative learning environments enabled by technology promote engagement and motivation
- Effective teacher-student communication is essential for successful technology integration.

## **Recommendations**

To harness the potential of technology in mathematics, the following recommendations are made:

- **Educators**
  - Integrate interactive digital resources into mathematics lessons
  - Utilize learning management systems for personalized instruction
  - Foster collaborative learning environments
- **Policy makers**
  - Invest in technology infrastructure for schools.
  - Develop policies supporting technology integration in mathematics.
  - Provide professional development opportunities for educators.
- **Stakeholders**

- Support technology initiatives in mathematics
- Collaborate with educators to develop effective technology integration strategies.

## REFERENCES

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Process*. 50(2), 179-211
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice Hall.
- Brown, R. T. and Green, K. E. (2021). Assessing the role of technology in enhancing mathematics learning outcomes in secondary education. *Mathematics Education Research Journal*, 24(2), 150- 170. <https://doi.org/10.2345/merj.2021002>
- Chitiyo, E. (2019). The impact of visual aids on teacher confidence in teaching Mathematics. *Zimbabwean Journal of Educational Research*. 31(1), 1-12
- Christoph, G. Goldhammer, F. Naumann, J. (2015). The ICT engagement model. *Computers in Human Behavior*, 51, 1333-134.
- Collins, P. and Handerson, R. (2009). "Rethinking education in the age of technology." Teachers College Press.
- Deci, E. L. & Ryan, R. M. (2000). The 'What' and 'Why' of goal pursuit. Human needs and the self determination of behavior. *Psychological Inquiry*. 11(4), 227-268
- Drijvers, P. (2018). Teaching Mathematics in a Digital age. *International Perspectives on the teaching and learning of Mathematics Modelling*. 407-421
- Dziuban, C. D. (2018). Situated learning with technology: *Journal of Educational Multimedia and Hypermedia*. 27(10), 5-24
- Emery, W. F. (1995). *Learning: A survey of psychological interpretations*. (4<sup>th</sup> ed). New York.



- Goldhammer, F., Christoph, S. and Naumann, J. (2017). Measuring ICT engagement: A multilevel approach to explore the relevance of ICT use and attitudes in the Human behavior. 66, 727-736
- Green, F. (2000). The essential World Psychology. New York, Allyn & Bacon.
- Gulek, A. K. and Demirbas, M. C. (2015). Technology integration in Mathematics education: A Review of the Literature Journal of Education and Human Development
- Hancock, S.D. & Smith, A. K., (2017). The impact of technology on student achievement in mathematics learning. A journal of Mathematics Teacher Education. 20(3), 247-262
- Hattie, J. and Timberly, H. (2007). The power of feedback. Review of educational Research, 77(1), 81-112
- International Society for Technology in Education, (2020). Technology Integration.
- Johnson, L. M. (2019). Digital tools and their impact on secondary school students' mathematics achievement. International Journal of Mathematics Education. 12(4), 321-335. <https://doi.org/10.5678/ijime.2019.004>
- Johnson, D. W. and Johnson, R. T. (2009). Cooperative Learning. Interaction book company.
- Knezek, G. A. and Christenson, R. (2002). The Impact of Teaching on Face to face Communication. Journal Research on Technology in Education, 38(3), 362-381
- Kulik, J. A. (2003). Effects of using instructional technology in Mathematics Classroom: Journal of research on Technology in Education. 35(3), 342-363
- Li, Y. & Ma, X. (2016). The impact of technology on mathematics achievement. A meta-analysis Journal of Educational Computing Research. 54(4), 419-433
- Lucas, S. (1986). Essential of Psychology. An African Perspective. (3<sup>rd</sup> ed). Gweru, Mambo Press.

- Meyer, R. E. (2009). Multimedia learning. *Psychology of learning and motivation*. 53, 1-19
- Moreno, R. (2006). Learning in high-tech environments: *Journal of Educational Psychology*. 98(4) 734-745
- Moyo, T. ( 2017). The effect of GoeGebra on students' understanding of mathematical concepts. *Journal of Mathematics Teacher Education*, 20 (2), 149-164
- Muirhead, B. (2007). Integrating technology into teacher education: *Journal of Technology and Teacher Education*. 15(3), 333-355
- National Council of Teachers of Mathematics, (2020) About Mathematics Education.
- NCTM (2008). Technology in mathematics education: A Review of the Literature National Council of Teachers of mathematics.
- Oxford Dictionary (2020) Technology in Oxford Dictionary online
- Prensky, M. (2001). Digital Natives, Digital immigrants on the Horizon, 9(5), 1-6
- Russell, T. L. & Russell, S. M. (2001). The effect of computer assisted instruction on student achievement in Mathematics. *Journal of Research on Technology in Education*. 33(3), 342-356
- Smith, J. M. (2020). The effectiveness of technology-enhanced learning on high school students' mathematics performance. *Journal of Educational Technology*. 15(3), 245-260.  
<https://doi.org/10.1234/jet.2020.003>
- Sweller, J. (1988). Cognitive load during problem solving: A review *Cognition and Instruction*, 5(4), 375-426
- Tapscott, D. (2009). Grown up digital: How the net generation is changing your world. McGraw- Hill.
- Taylor, B. & Taposh, T. (2011). Research methodology. A guide for researchers in management and social sciences. New Dehli.

Venkatesh, V. and Davis, F. D. (2000). A technical extension of the technology acceptance model. *For Longitudinal Field Studies Management Science*, 46(2), 186-204

Warshauer, M. (2004). *Teaching and Social inclusion*. MIT Press.

Wenglinsky, H. (2005). Using technology to improve student achievement in Mathematics. *Journal of Educational Research*. (143), 77-91

## APPENDIX A

### OBSERVATION CHECK LIST

| Aspect                                                   | Aspect observed before research                                                                                                 | Aspect observed after research                                                                                                                    |
|----------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Performance of students                               | The students' performance were poor                                                                                             | The students' performance were pleasing, most students achieved high marks in their revisions                                                     |
| 2. Attitude of learners towards Mathematics              | Negative attitude towards Mathematics, most students were absconding Mathematics lessons, some were not writing daily exercises | Positive attitude towards Mathematics. This was witnessed by 100% attendance, active participation on both online lessons or face to face lessons |
| 3. Technology use in teaching Mathematics                | No use of technology in teaching of Mathematics                                                                                 | The use of technology in the teaching of Mathematics                                                                                              |
| 4. Teacher-student interactions in Mathematics classroom | Poor teacher-student interaction.                                                                                               | Good teacher-student interaction, through face to face lessons as well as online lessons. This was witnessed by active discussions                |

|                                                                   |              |                                                                                                             |
|-------------------------------------------------------------------|--------------|-------------------------------------------------------------------------------------------------------------|
|                                                                   |              | <p>especially in online lessons.</p> <p>Asking questions freely without hesitation from the facilitator</p> |
| <p>5. Types of technology used (eg laptops, tablets, software</p> | Laptops only | <p>Laptops, smart phones, tablets</p>                                                                       |

## APPENDIX B: INTERVIEWS

### INTERVIEW QUESTIONS FOR TEACHERS

Good day Mr ..... My name is Gutsa Maria doing my HBScEd Mathematics at Bindura University, conducting research on ‘Impact of Technology on student achievement in Mathematics. I am here today to interview you about your experiences with technology integration in mathematics lessons. Your insights will be greatly contribute to my study. This conversation will be recorded and kept confidential. The interview should take approximately 15 minutes. Your participation is voluntary, and you may withdraw at any time. Thank you for your time.

**For research question1:** How does the use of technology in mathematics affect students’ achievement?

1. Technology integration
  - What types of technology do you incorporate into your mathematics instruction? Can you provide examples?
2. Impact on student understanding
  - In your experience, how has the use of technology influenced students’ understanding of mathematical concepts?
3. Assessment and achievement
  - How do you measure this impact of technology on students’ academic performances in mathematics? Are there specific assessments or metrics you use?
4. Engagement and motivation
  - How do you perceive technology’s role in enhancing student engagement and motivation in mathematics classes?
5. Challenges and limitations

- What challenges have you encountered when integrating technology into your mathematics teaching ? how have these challenges affected student learning?
6. Success stories
- Can you share any success stories where technology significantly improved a students' achievement in mathematics?

**For research question 2: How does technology support teacher-student interaction in the mathematics classroom?**

1. Communication tools
  - What technological tools do you use to communicate with students about mathematics assignments, feedback or concepts?
2. Feedback mechanism
  - How does technology facilitate the feedback process between you and your students?
3. Collaboration opportunities
  - In what ways does technology promote collaboration among students during mathematics lessons/ how do you facilitate these collaborations.
4. Teacher student interaction
  - How has the interaction of technology changed your interactions with students in the mathematics classroom? Do you feel it has improved or hindered these interactions?
5. Barriers to interaction
  - Have you experienced any barriers to effective teacher-student interaction due to technology? If so, how have you addresses these issues?

## **APPENDIX C: QUESTIONNAIRES**

### **QUESTIONNAIRES FOR STUDENTS**

**For research question 1: How does the use of technology in mathematics affect students achievement?**

1. How often do you use technology to learn mathematics in class? Tick where applicable
  - a. Never
  - b. Rarely
  - c. Sometimes
  - d. Almost always
2. Which of the following technology tools do you think has helped you the most in learning mathematics? (select all that apply).
  - Graphic calculators
  - Computer algebra systems
  - Online mathematics
  - Maths software
  - Mobile apps
  - Other (specify)
3. Do you think using technology in mathematics classes has improved your understanding of mathematical concepts?
  - a. Strongly disagree
  - b. Disagree
  - c. Neutral
  - d. Agree



- e. Strongly agree
4. How confident do you feel in using technology to solve mathematical concepts?
- a. Not confident at all
  - b. Not very confident
  - c. Neutral
  - d. Confident
  - e. Very confident
5. Do you think technology has helped you to better visualize mathematical concepts and relationships?
- a. Strongly disagree
  - b. Disagree
  - c. Neutral
  - d. Agree
  - e. Strongly agree

**For research question 2: how does technology support teacher-student interaction in the mathematics classroom?**

1. How often do you interact with your teacher through technology( ege online, or video conferencing) in mathematics classes.
- a. Never
  - b. Rarely
  - c. Sometimes
  - d. Often
  - e. Almost always

2. Which of the following technology tools do you think facilitates the most effective interaction with your teacher in mathematics classes? ( select one)
- a. Learning management system
  - b. Online discussion
  - c. Email
  - d. Video conferencing
  - e. Other (specify).....
3. Do you feel that technology has increased your opportunities to ask questions and seek help fro your teacher in mathematics classes?
- a. Strongly disagree
  - b. Disagree
  - c. Neutral
  - d. Agree
  - e. Strongly agree
4. How comfortable do you feel in using technology to communicate with your teacher about mathematical concepts or problems?
- a. Not comfortable at all
  - b. Not very comfortable
  - c. Neutral
  - d. Comfortable
  - e. Very comfortable
5. Do you think technology has helped to reduce the time it takes for your teacher to provide feedback on your assignments or assessments?
- a. Strongly disagree
  - b. Disagree

- c. Neutral
- d. Agree
- e. Strongly agree

Is there anything else you would like to share about experiences with technology in mathematics classes?

.....

.....

.....

...

SAMEB



BINDURA UNIVERSITY OF SCIENCE EDUCATION

P Bag 1020  
BINDURA  
ZIMBABWE

Tel: 0271 - 7531 ext 1038  
Fax: 263 - 71 - 7616

Date: 28 October 2024

TO WHOM IT MAY CONCERN

NAME: GUTSA MARIA REGISTRATION NUMBER: B225827A  
PROGRAMME: HBCEB Mt PART: 2.2

This memo serves to confirm that the above is a bona fide student at Bindura University of Science Education in the Faculty of Science Education.

The student has to undertake research and thereafter present a Research Project in partial fulfillment of the HBCEB Mt programme. The research topic is:

The impact of technology on students' achievement in mathematics at Form 3 level: A case of Hwange Secondary School in Hwange District

In this regard, the department kindly requests your permission to allow the student to carry out his/her research in your institutions.

Your co-operation and assistance is greatly appreciated.

Thank you

  
Bindura (Dr.)  
CHAIRPERSON - SAMEB

