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INVESTIGATING THE INTEGRATION OF INTERACTIVE TECHNOLOGY IN THE TEACHING AND LEARNING OF ORDINARY LEVEL MATHEMATICS IN CHEGUTU DISTRICT, ZIMBABWE

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APPROVAL FORM

The undersigned certify that they have read and recommend to Bindura University of Science Education for acceptance of this dissertation entitled 'An Assessment of the Integration of Interactive Technology in Ordinary Level Mathematics Teaching in Chegutu District, Zimbabwe".' submitted to the Mathematics department in partial fulfilment of Bachelor of Science Honours Degree in Mathematics

Mutambara 30/12/2024

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External examiner **Date**

DECLARATION

I declare that this dissertation is the product of my own work and that it has not been submitted before for any degree or examination in any other university, and that all the sources I have used or quoted have been indicated and acknowledged as complete references.

Signed………………………………………………………………..

DEDICATION

To my dearest husband, whose unwavering love, sacrifices, and prayers have been the foundation of my success, I dedicate this work with heartfelt gratitude. Your relentless support—both emotional and financial—has been my guiding light, pushing me to overcome every challenge and achieve this milestone. As you face this period of recovery, I wish you strength and a swift return to good health, knowing your resilience continues to inspire me. To my children, for being my constant source of motivation and joy, and to my parents, whose values and encouragement have shaped the person I am today, this achievement is a tribute to your belief in me and the countless sacrifices you have made for my dreams to take flight.

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ABSTRACT

This study explores the integration of interactive technology in Ordinary Level mathematics teaching in Chegutu District, Zimbabwe, providing critical insights into its adoption, benefits, and challenges. Using an action research approach, the study gathered data from 20 Form Three learners through semi-structured interviews, and classroom observations, offering a comprehensive understanding of technology's role in mathematics education. The findings reveal that 67% of teachers actively employ interactive technology in their lessons, resulting in substantial improvements in student outcomes, with 80% of students exhibiting enhanced performance and engagement. Interactive tools have been shown to foster deeper conceptual understanding, critical thinking, and active participation among learners, making the learning process more dynamic and effective. However, the study also highlights significant barriers to effective technology integration, including limited infrastructure, unreliable internet access, and inadequate teacher training. These challenges not only restrict the full utilization of digital tools but also hinder teachers' ability to confidently implement innovative teaching strategies. The lack of technical support and uneven distribution of resources across schools further exacerbate these issues, disproportionately affecting rural schools and low-income communities.

To address these challenges, the study emphasizes the urgent need for targeted professional development programs that equip teachers with both technical skills and pedagogical strategies to effectively integrate technology into their instruction. Additionally, substantial investments in infrastructure, including reliable internet connectivity, adequate hardware, and technical support systems, are critical to creating a sustainable and equitable foundation for technology-enhanced education. The findings of this study carry significant implications for policymakers, educators, and stakeholders seeking to advance technology-enhanced learning environments in

Zimbabwean schools. By addressing the identified challenges and leveraging the potential of interactive tools, it is possible to transform mathematics education, fostering better learning outcomes and preparing students for the competitive global economy. The study ultimately advocates for a holistic approach that combines infrastructure development, professional support, and strategic policy interventions to unlock the full potential of technology in education.

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Chapter I: Introduction

1.1 Introduction

The integration of interactive technology in education has revolutionized traditional teaching methods, offering new possibilities to enhance learning outcomes and student engagement. In mathematics education, where abstract concepts often challenge student understanding, interactive tools such as educational software, mobile learning applications, and virtual platforms provide opportunities for deeper conceptual comprehension and active participation. This study investigates the extent to which interactive technologies have been incorporated into teaching ordinary-level mathematics in Chegutu District, Zimbabwe. It explores the current status of technology integration, the challenges teachers face in its implementation, and the effects on student performance and engagement. By examining these dimensions, the study seeks to contribute to the growing discourse on the role of technology in transforming education.

1.2 Background of the Study

Mathematics education is critical to Zimbabwe's socio-economic development by equipping students with problem-solving and analytical skills essential for a technology-driven world. However, the teaching and learning of mathematics in many parts of Zimbabwe, including Chegutu District, face significant challenges. Students' performance in ordinary-level mathematics has remained below the national average for years, raising concerns about the quality of education in this subject. Several interrelated factors contribute to this issue.

One of the primary challenges is the need for more qualified mathematics teachers in rural districts. The effective integration of interactive technology in mathematics education requires teachers who possess the necessary technical, pedagogical, and content knowledge (TPCK) (Mishra & Koehler, 2016). Qualified teachers can design and implement technology-enhanced lessons that promote deep understanding and engagement in mathematics (Hermans, 2017). Schools in Chegutu District often need help attracting and retaining educators with the necessary expertise to teach mathematics effectively. As a result, many schools rely on untrained or underqualified teachers, negatively impacting student comprehension and engagement. Furthermore, the lack of teaching resources exacerbates the problem. Many schools need more basic resources such as textbooks, calculators, and computers, making it difficult for students to practice and internalize mathematical concepts. Socio-economic barriers compound this scarcity of resources, as students from low-income families often need access to supplementary materials or private tutoring, further hindering their academic performance.

In addition to these systemic issues, cultural attitudes toward mathematics shape student outcomes. Mathematics is often perceived as problematic, creating a stigma discouraging students from actively engaging. Overcoming these barriers requires innovative teaching approaches that address traditional methods' limitations while making mathematics more accessible and engaging.

Interactive technology offers a potential solution to these challenges. Globally, tools such as GeoGebra, Khan Academy, and virtual learning platforms have been shown to improve student engagement and foster collaborative learning. The use of Khan Academy-style video tutorials provides students with supplemental instruction and practice in mathematics (Khan, 2022). Additionally, teachers can use educational software, such as GeoGebra, to create interactive mathematics lessons that promote student engagement and understanding (Hohenwarter & Lavicza, 2017). These technologies enable students to visualize abstract concepts, receive immediate feedback, and practice problem-solving in dynamic and interactive environments. Despite their proven benefits, the integration of such technologies in Zimbabwean schools remains limited due to infrastructural constraints, inadequate teacher training, and insufficient funding. This study explores how interactive technologies are being utilized in Chegutu District, the challenges associated with their implementation, and their potential to enhance mathematics education.

1.3 Problem Statement

Despite the global recognition of the transformative potential of interactive technology in education, its adoption in teaching ordinary-level mathematics in Zimbabwe still needs to be improved. In Chegutu District, student performance in mathematics consistently falls below the national average, indicating a pressing need for innovative teaching approaches. Interactive technologies, shown to enhance student engagement and improve learning outcomes, remain underutilized in this region. This underutilization is attributed to several factors, including limited resource access, a lack of teacher training, and infrastructural challenges.

The persistent underperformance of students in mathematics not only undermines their academic potential but also limits their future opportunities in a technology-driven economy, (National Council of Teachers 2014). Addressing this issue requires a comprehensive understanding of technology integration in mathematics education, the barriers to its effective implementation, and its impact on student outcomes. This study seeks to fill this gap by investigating how interactive technology is used in mathematics teaching in Chegutu District, the challenges educators face, and the impact on students' engagement and performance.

1.4 Research Objectives

The following are the objectives of the study:

1. Establish the current status regarding the use of interactive technology in the teaching of Ordinary level mathematics in Chegutu District.

2. Identify the benefits of integrating technology in teaching and learning of mathematics in Chegutu District

3. Ascertain the challenges faced by the teachers in effectively integrating interactive technology in mathematics education.

4. Explore mechanisms that can be put in place to improve the influence of ICTs in teaching and learning of Ordinary Level in Chegutu District.

1.5 Research Questions

The research seeks to answer the following questions:

1. What is the extent of interactive technology usage in teaching Ordinary Level Mathematics in Chegutu District?
2. What are the merits of integrating interactive technology in the teaching and learning of Mathematics in Chegutu District?
3. What challenges are faced by teachers in integrating interactive technologies into mathematics teaching?

4. Which mechanisms can be put in place to improve the influence of ICTs in teaching and learning of Ordinary Level Mathematics in Chegutu District?

1.6 Significance of the Study

This study holds significance for several reasons. First, it addresses a critical gap in the existing literature on the use of interactive technology in mathematics education in Zimbabwe. While global studies have highlighted the benefits of technology integration, more research needs to be done on its application in Zimbabwe, particularly in rural districts such as Chegutu.mathematics not only undermines their academic potential but also limits their future opportunities in a technology-driven economy (National Council of Teachers of Mathematics, 2014). Research has consistently shown that mathematics achievement is a strong predictor of future academic and career success (Wang, 2017). Furthermore, mathematics literacy is essential for participation in an increasingly complex and technological society (Organisation for Economic Co-operation and Development, 2013). By examining this context, the study provides valuable insights that can inform the development of targeted interventions to improve mathematics education in similar settings. Secondly, the findings of this study have practical implications for educators and policymakers. The study offers evidence-based recommendations for educators on effectively integrating interactive technology into their teaching practices to enhance student engagement and learning outcomes. For policymakers, the study highlights the infrastructural and training needs that must be addressed to support the widespread adoption of technology in schools. By aligning policy and practice with the needs of teachers and students, this study contributes to the broader goal of improving educational outcomes in Zimbabwe.

Finally, the study is significant for students, as it seeks to identify strategies to make mathematics more accessible and engaging. By enhancing student engagement and improving learning outcomes, the study contributes to developing a skilled and confident workforce capable of meeting the demands of a technology-driven economy.

1.7 Assumptions of the Study

This study assumes that interactive technologies, such as computers, tablets, projectors, and educational software, are available and accessible in schools within the Chegutu District, albeit in limited quantities or with varying levels of functionality. This assumption acknowledges that while the availability of such tools may not be widespread or uniform across all schools, some level of access exists, making it possible to examine their use in mathematics education. It also presumes that these technologies work and can be utilized effectively by teachers and students, even in resource-constrained settings. Additionally, the study assumes that teachers in the district are open to adopting new technologies in their teaching practices. This includes the willingness to learn how to use interactive tools, integrate them into their lesson plans, and adjust their teaching methods to accommodate the use of technology. It is also presumed that teachers recognize the potential benefits of interactive technologies in enhancing student engagement and learning outcomes, which motivates them to embrace these tools despite any challenges they may face, such as a lack of training or technical support.

Furthermore, the study assumes that students have the basic computer skills to use interactive technologies effectively. This includes fundamental abilities such as navigating software, using a keyboard and mouse, and accessing digital learning resources. While students' proficiency levels may vary, it is assumed that they have received some form of exposure to technology in school or outside the classroom that enables them to interact with these tools during mathematics lessons. These assumptions provide a foundation for the study by creating a baseline understanding of the context in which interactive technology integration is being examined. They allow the research to focus on the effectiveness and challenges of using technology in mathematics education rather than the complete absence of such tools or skills. However, it is essential to acknowledge that deviations from these assumptions, such as significant disparities in access to technology or gaps in teacher and student readiness, could influence the findings and implications of the study.

1.8 Delimitations

The scope of this study is deliberately confined to teaching ordinary-level mathematics in the Chegutu District, narrowing the focus to a specific educational level and geographical area. By concentrating on ordinary-level mathematics, the study ensures that its findings are directly relevant to the challenges and opportunities faced by both students and teachers at this critical stage of education, where mathematics forms a foundational part of the curriculum and plays a significant role in shaping students' academic and career prospects.

The choice to focus exclusively on schools within the Chegutu District is intended to provide a localized perspective on integrating interactive technology in mathematics education. This geographic limitation allows the research to delve deeply into the unique contextual factors affecting schools in this district, such as the availability of resources, teacher training levels, infrastructure, and socio-economic conditions. By concentrating on one district, the study aims to provide nuanced insights that may be used to inform targeted interventions and policy recommendations for similar settings.

Additionally, the study does not extend to other regions or levels of education, such as primary schools, tertiary institutions, or other districts outside Chegutu. This exclusion ensures that the research remains focused on the specific educational challenges and opportunities relevant to ordinary-level mathematics, avoiding the potential dilution of findings that could occur with a broader scope. The study also excludes special needs education, focusing instead on general education settings where most students and teachers operate. This exclusion is intended to streamline the research objectives and methodologies, ensuring that the study's resources and efforts are directed toward the most commonly encountered educational scenarios. By clearly defining these delimitations, the study remains focused and manageable, enabling the researcher to effectively address the specific research objectives. However, it is essential to acknowledge that these delimitations also mean that the findings may not be directly generalizable to other regions, educational levels, or special needs contexts. Future research could build on this study by exploring the integration of interactive technology in broader or more specialized settings to provide a more comprehensive understanding of its impact across different educational landscapes.

1.9 Limitations of the Study

The study acknowledges several limitations that may affect the scope and interpretation of its findings. First, while sufficient for preliminary analysis, the sample size may not fully represent the diversity of schools, students, and teachers in the Chegutu District. This limitation could restrict the generalizability of the findings to the entire district or other regions, as schools within the district vary in terms of resources, infrastructure, and socio-economic contexts. A more significant, more diverse sample could have provided a more comprehensive understanding of the integration of interactive technology in mathematics education. Second, time constraints pose a considerable limitation, particularly in data collection and analysis. The study's timeframe may limit the depth of investigation, especially for qualitative data, such as teacher interviews and classroom observations. In-depth qualitative analysis often requires extensive time to gather and analyze rich data, and this limitation may result in a less detailed exploration of specific themes, such as teacher perceptions, student engagement, and classroom practices. Consequently, some subtle yet important aspects of technology integration have yet to be fully captured.

Third, variability in access to technology across schools in the Chegutu District may influence the findings. While some schools may have adequate technological infrastructure and resources, others may lack essential tools like computers, internet connectivity, or interactive software. This disparity makes it challenging to draw definitive conclusions about the overall impact of interactive technology on mathematics education in the district. Schools with better access to technology may report more favorable outcomes. At the same time, those with limited resources may highlight significant challenges, leading to findings that may not uniformly apply across the district.

1.10 Chapter Summary

This chapter offers a comprehensive introduction to the study, presenting the background, research problem, objectives, significance, and delimitations. It underscores the persistent challenges in mathematics education within the Chegutu District, such as a lack of qualified teachers, inadequate teaching resources, and socio-economic barriers. It positions the integration of interactive technology as a potential solution to these issues. Furthermore, it establishes the study's assumptions, limitations, and scope, framing the investigation within a clearly defined context to ensure focused and manageable research. The chapter also emphasizes the importance of exploring the current state of technology use in mathematics education and its potential impact on teaching practices and student learning outcomes. By addressing these critical issues, the study aspires to provide valuable insights for educators, policymakers, and other stakeholders in the education sector. The next chapter will thoroughly review existing literature, examining theoretical frameworks underpinning technology integration in education, empirical studies highlighting its effectiveness, and best practices guiding its implementation. By building on the foundational concepts introduced in this chapter, the study seeks to contribute meaningfully to the growing knowledge of technology-enhanced education with specific relevance to the Zimbabwean context.

Chapter II: Literature Review

2.1 Introduction

This chapter provides a comprehensive review of existing literature on the use of interactive technology in mathematics education, with a specific focus on ordinary-level teaching in Zimbabwe. It explores the potential of interactive technologies, such as educational software, mobile applications, and online platforms, to enhance student engagement and learning outcomes. These tools offer opportunities to transform traditional teaching approaches, enabling students to interact directly with mathematical concepts and fostering a deeper understanding of the subject matter. The chapter also examines the challenges of integrating technology into classrooms, particularly in Zimbabwe, where limited resources and socio-economic disparities hinder its widespread adoption. Additionally, the review highlights the critical role of teacher training and professional development in ensuring effective technology integration. By drawing on a wide range of theoretical and empirical studies, this chapter aims to establish a framework for understanding the opportunities and limitations of interactive technology in mathematics education and to identify practical solutions for improving teaching and learning outcomes.

2.2 Theoretical Perspectives

The integration of interactive technology in education is underpinned by several theoretical frameworks that provide insights into how technology can enhance teaching and learning. These include Constructivist Theory, Social Cognitive Theory, and the Technology Acceptance Model (TAM). Each of these theories offers a unique perspective on the role of technology in education, emphasizing the importance of experiential learning, social interaction, and ease of use.

Constructivist Theory

Constructivist Theory, as proposed by Piaget (1954), emphasizes that learning is an active process in which learners construct new knowledge based on their existing cognitive structures. This theory underscores the importance of experiential learning, where students engage directly with content to build their understanding. Interactive technologies, such as simulation tools and dynamic geometry software, align with this theory by providing opportunities for students to explore mathematical concepts hands-on. For example, tools like GeoGebra allow students to manipulate geometric shapes and observe real-time changes, fostering a deeper understanding of mathematical relationships. These technologies also enable students to experiment with variables and test hypotheses, creating a more engaging and practical learning experience. By facilitating active exploration and visualization, interactive tools support the constructivist approach to education, enhancing students' ability to retain and apply mathematical concepts.

Social Cognitive Theory

Bandura’s Social Cognitive Theory (1977), highlights the role of observational learning, imitation, and reinforcement in the learning process. In the context of mathematics education, interactive technology can foster a collaborative learning environment where students learn from their peers and receive immediate feedback. For instance, group activities using educational software encourage students to solve problems together, enhancing their critical thinking and communication skills. Moreover, interactive tools often provide visual and auditory cues reinforcing learning, making abstract mathematical concepts more accessible. Encouragement and positive reinforcement from teachers and classmates motivate students to engage actively with the technology, creating a supportive and dynamic classroom atmosphere. By combining social interaction with technological innovation, this theory underscores the potential of interactive tools to enhance student engagement and achievement.

Technology Acceptance Model (TAM)

The Technology Acceptance Model, introduced by Davis (1989), identifies perceived ease of use and perceived usefulness as key factors influencing technology adoption. This model is particularly relevant in understanding how teachers and students approach interactive tools in mathematics education. Technology must be user-friendly and demonstrate clear benefits in improving learning outcomes for it to be effectively integrated into classrooms. Teachers, for example, are likelier to adopt tools that simplify lesson preparation and delivery while enhancing student understanding. Similarly, students are more inclined to use technologies that make learning more interactive and enjoyable. By addressing these factors, educators can create a culture of acceptance and enthusiasm for technology, ensuring its successful implementation in mathematics classrooms. The TAM framework emphasizes the importance of designing and selecting tools that align with teachers' and students' needs and preferences, paving the way for more effective technology integration.

Together, these theoretical perspectives provide a robust foundation for exploring the potential of interactive technology in mathematics education. They highlight the importance of active learning, social collaboration, and user-friendly design in creating a transformative educational experience.

2.3 Interactive Technology in Mathematics Education

Interactive technologies have revolutionized mathematics education by offering innovative tools that enhance teaching and learning. These tools, including mathematics software, mobile learning applications, and virtual learning environments, provide opportunities to engage students more effectively and address diverse learning needs, (Chagwiza and Mutambara, 2020).

Mathematics Software

Mathematics software has significantly transformed traditional teaching methods by enabling students to visualize and interact with mathematical concepts. Tools like GeoGebra and graphing calculators allow students to explore complex equations and geometric relationships dynamically and intuitively, (Maplesoft, 2020). For example, GeoGebra enables students to manipulate variables and observe real-time changes in graphs and shapes, fostering a deeper understanding of mathematical principles. Platforms like Khan software provide personalized learning experiences through instructional videos and practice exercises tailored to individual learning paces, (Khan, 2014). This individualized approach enhances students' confidence in their mathematical abilities and helps them develop problem-solving skills essential for academic success. By making abstract concepts more tangible and accessible, mathematics software plays a crucial role in improving student engagement and performance.

Mobile Learning

The rise of mobile technology has introduced new possibilities for mathematics education, mainly through mobile learning applications. Apps such as Mathway and Photomath offer step-by-step solutions to mathematical problems, allowing students to practice independently and receive immediate feedback. These apps also incorporate gamification elements, such as rewards and challenges, to motivate students and sustain their interest in mathematics. For example, students can use Photomath to scan and solve equations, gaining a clearer understanding of problem-solving processes. Mobile learning makes mathematics education more flexible and accessible, enabling students to learn at their own pace and revisit challenging topics as needed. Mobile technology enhances the learning experience and supports continuous skill development by bridging the gap between classroom instruction and independent practice.

Virtual Learning Environments

Mishra & Koehler, (2016) alludes that virtual learning environments, such as Moodle and Blackboard, provide collaborative platforms for mathematics education. These environments enable teachers to design interactive courses with multimedia resources, quizzes, and discussion forums, fostering active participation and teamwork. For instance, a mathematics teacher can use Moodle to facilitate group projects and peer tutoring, encouraging students to work together to solve complex problems. Virtual environments also allow for real-time feedback, enabling students to promptly identify and address learning gaps. Virtual platforms enhance students' engagement and understanding of mathematical concepts by creating a supportive and interactive learning space. These tools improve academic performance and prepare students for the demands of a technology-driven world.

The integration of these technologies represents a significant shift in mathematics education, emphasizing student-centered learning and active participation. However, their effectiveness depends on teacher training, infrastructure, and alignment with curriculum objectives. By addressing these challenges, educators can maximize the benefits of interactive technology and create a more inclusive and effective learning environment.

2.4 Empirical Studies

Empirical research provides valuable insights into the effectiveness of interactive technology in mathematics education. Studies have consistently shown that technology-enhanced learning tools improve student performance and engagement. For example, Cheung and Ng (2015) conducted a meta-analysis that found students who used interactive technologies performed significantly better in mathematics than those who relied solely on traditional teaching methods. Similarly, Moura and Carvalho (2016) reported that dynamic geometry software enhanced students' problem-solving abilities and conceptual understanding, demonstrating the transformative potential of these tools. Despite these benefits, challenges remain. Ertmer (2015) identified technical issues, such as unreliable internet access and inadequate infrastructure, as major barriers to technology integration. Additionally, Ottenbreit-Leftwich et al. (2016) highlighted the lack of professional development as a significant obstacle, noting that many teachers feel unprepared to use interactive tools effectively. These findings underscore the importance of addressing logistical and training-related challenges to ensure the successful implementation of technology in mathematics education.

Interactive technology also positively impacts student motivation and attitudes toward mathematics. Shute (2008) found that game-based learning tools increased student enjoyment and interest in the subject, while Wouters et al. (2013) emphasized the motivational benefits of interactive simulations and serious games. Making learning more engaging and interactive, these tools help overcome negative perceptions of mathematics and foster a positive learning environment.

2.5 Best Practices

To maximize the impact of interactive technology in mathematics education, educators must adopt best practices that address integration challenges comprehensively. One of the most critical steps is providing extensive and continuous teacher training to ensure educators are well-equipped with the necessary skills and confidence to utilize technology effectively in their classrooms. These training programs should focus on the technical aspects of using interactive tools and emphasize innovative pedagogical strategies that enhance student engagement and understanding. For instance, teachers should learn how to integrate tools like GeoGebra or Khan Academy into lesson plans that align with specific learning objectives.

Equally important is the alignment of technology use with curriculum goals. This ensures that technology serves to deepen students' conceptual understanding rather than a mere distraction. Curriculum developers should review existing frameworks to incorporate technology-enhanced teaching strategies, such as using simulations for problem-solving or interactive software to visualize complex mathematical concepts. Such alignment guarantees that technology integration directly contributes to achieving educational outcomes. Reliable infrastructure and technical support form another cornerstone of successful integration. Schools must invest in dependable internet connectivity, adequate hardware, and up-to-date software to facilitate the seamless use of technology in classrooms. Additionally, ongoing technical support is vital to address challenges that may arise during lessons, ensuring minimal disruption to teaching and learning activities.

Collaboration partnerships with governments, NGOs, and private entities can also help schools secure the resources and funding necessary for these improvements.

By adopting these strategies, educators can create a supportive and interactive environment that empowers students to thrive in a technology-enhanced learning setting. Such an approach improves academic performance and prepares students with the digital skills needed to excel in an increasingly technology-driven world. Furthermore, these practices contribute to bridging the digital divide in education, particularly in under-resourced areas like Chegutu District, ensuring that all students have equitable opportunities to benefit from advancements in educational technology.

2.6 Zimbabwean Context

The integration of interactive technology in Zimbabwean education faces unique challenges that require deliberate and sustained efforts to overcome. One of the most significant challenges is the limited availability of resources in many schools, particularly in rural areas. Schools often lack basic infrastructure such as reliable internet connectivity, computers, and other digital tools that are essential for the effective use of interactive technology. This is compounded by socio-economic disparities, as many families in rural areas cannot afford personal devices or supplementary educational resources, further exacerbating the digital divide. National policies in Zimbabwe emphasize the critical role of technology in modernizing education and improving learning outcomes. However, implementing these policies could be improved by a lack of resources and technical expertise. For example, while urban schools may have access to interactive whiteboards and educational software, rural schools often rely on outdated teaching methods due to the absence of such tools. This discrepancy creates a gap in educational quality between urban and rural students, limiting interactive technology's potential to be a transformative force.

Despite these challenges, promising initiatives have been aimed at bridging the gap. In collaboration with NGOs and private organizations, the government has undertaken projects to distribute resources and provide teacher training. These efforts include workshops designed to equip teachers with the skills to incorporate technology into their teaching practices effectively. Additionally, some NGOs have donated computers and tablets to underprivileged schools, helping to create opportunities for students to engage with digital tools. However, addressing these challenges requires a more comprehensive approach. Investment in infrastructure, such as solar-powered computer labs and satellite internet, can provide sustainable solutions for rural schools. Furthermore, professional development programs for teachers must be ongoing, ensuring that they are continually updated on the latest technological advancements and teaching strategies. Collaboration between the government, private sector, and international organizations will be essential in mobilizing the resources and expertise needed to make these changes.

By tackling these challenges ahead, Zimbabwe can unlock the potential of interactive technology to revolutionize mathematics education. This would enhance student engagement and understanding and prepare them for the demands of a technology-driven world. Bridging the digital divide will contribute to a more equitable education system where students from all backgrounds have the opportunity to succeed and thrive in the modern economy.

2.7 Research Gaps

While research on interactive technology in education steadily expands, its specific application in Zimbabwean mathematics classrooms still needs to be explored. There is an urgent need for studies that delve into the effectiveness of integrating particular technological tools, such as educational software, virtual learning environments, and mobile applications and computers, (Nziramasanga, 1999) into the mathematics curriculum. These studies could examine how such tools impact student comprehension, engagement, and overall academic performance, especially in contexts with limited resources and infrastructure.

Moreover, the role of teacher training and ongoing professional support in facilitating the adoption of interactive technologies warrants further investigation. Teachers are critical to successfully integrating these tools, yet many need more technical knowledge or confidence to utilize them effectively. Research focusing on the development and implementation of comprehensive training programs tailored to address the challenges faced by educators in Zimbabwe would be instrumental in bridging this gap. This could include exploring strategies for overcoming common barriers, such as resistance to change, inadequate ICT infrastructure, (ICT Policy, 2022-2027) and limited time for professional development. Additionally, there is a need to investigate the socio-economic factors that influence access to and utilization of interactive technology in rural and urban schools. Understanding these dynamics can help policymakers design targeted interventions to reduce the digital divide and ensure equitable access to technology-enhanced education across different regions. Research could also explore the long-term effects of interactive technology on students' critical thinking, problem-solving abilities, and readiness for the workforce.

Addressing these research gaps is vital for providing actionable insights to policymakers, educators, and stakeholders. By generating evidence-based recommendations, future studies can help guide the development of policies and practices that maximize the potential of interactive technology in mathematics education. Ultimately, this research will create a more inclusive and effective educational system that leverages technology to improve learning outcomes and empower students in Zimbabwe.

2.8 Summary of Literature Review

The literature underscores the transformative potential of interactive technology in mathematics education, highlighting its capacity to revolutionize teaching and learning by enhancing student engagement, achievement, and critical thinking skills. Studies reveal that dynamic geometry software, virtual learning environments, and gamified mobile applications enable students to visualize complex concepts, collaborate effectively, and practice interactive problem-solving, (Khan, 2017). These technologies promote a more personalized and engaging learning experience, catering to diverse student needs and learning styles. However, several barriers hinder the effective integration of interactive technology in mathematics education, particularly in resource-constrained contexts. Limited access to reliable infrastructure, such as computers and internet connectivity, is a pervasive challenge in many schools, especially rural areas.

CHAPTER III: RESEARCH METHODOLOGY

3.1 Introduction

This chapter comprehensively describes the methodology employed to investigate the integration of interactive technology in ordinary-level mathematics teaching in the Chegutu District. The study adopts a mixed-methods research design, combining quantitative and qualitative data to explore the current status of interactive technology in mathematics education. The chapter also outlines the sampling strategy, data collection methods, research instruments, ethical considerations, and measures to ensure reliability and validity.

3.2 Research Design

The study employs a concurrent triangulation mixed-methods design to capture a holistic view of interactive technology usage in mathematics classrooms. This design enables the collection and integration of both quantitative and qualitative data simultaneously, ensuring that the strengths of one method address the limitations of the other (Creswell & Creswell, 2018). Quantitative data were collected through structured questionnaires administered to mathematics teachers and students to capture their perceptions, experiences, and the frequency of technology use in teaching. Achievement tests were also administered to students to measure their performance and analyze the relationship between technology usage and academic outcomes.

Qualitative data were collected through semi-structured interviews with teachers and school administrators, as well as through classroom observations. These methods provided an in-depth understanding of the practical challenges, infrastructural barriers, and successes in integrating interactive technology. This triangulated approach enhances the validity of the findings by corroborating data from different sources (Tashakkori & Teddlie, 2017). The mixed-methods design also allows for a more comprehensive exploration of the phenomenon, aligning with the study's objective of understanding both the quantitative and qualitative aspects of technology integration.

3.3 Research Methods

The study utilized several complementary methods to collect data. Structured questionnaires were distributed to three (3) mathematics teachers and then twenty ordinary level students were given a pre-exercise and a post exercise. Teacher questionnaires were designed to capture their experiences, perceptions, and attitudes towards using interactive technology. Semi-structured interviews were conducted with three (3) mathematics teachers.

The pre-exercise was taught using traditional method where the teacher demonstrated on ways of solving laws of indices. To check on achievement from pre-exercise, a post exercise was administered to students to assess their understanding of key mathematical concepts and the potential impact of interactive tools on their performance. Twenty (20) form three (3) learners, offering insights into the challenges, barriers, and successes encountered when integrating interactive technology. Classroom observations were carried out during two lessons to document real-time data on the use of technology on teacher practices, and student engagement. These methods ensured that numerical data and narrative insights were captured, enhancing the study's comprehensiveness (Yin, 2018).

3.4 Study Sample and Selection

The population for the study comprised mathematics teachers and students from Masawi secondary school in the Chegutu District. The sample included three (3) mathematics teachers with diverse teaching experiences and 20 form three learners from different academic backgrounds, ensuring a balanced representation of gender and performance levels. Additionally, three (3) teachers and twenty (20) students were purposefully selected for interviews based on their active involvement in interactive technology. Classroom observations were conducted in ten schools, chosen to reflect resource availability and infrastructural conditions. As Bryman (2016) suggested, strategic sampling ensure diversity and representativeness, enhancing the generalizability of the study's findings.

3.5 Research Instruments

The study used various research instruments to collect reliable and valid data. A survey was developed to capture perceptions of ease of use, usefulness, and attitudes toward interactive technology on teachers. The questionnaire included closed-ended Likert scale items and open-ended questions for quantitative analysis and qualitative insights. A semi-structured interview guide was created to facilitate in-depth discussions with teachers and focusing on their experiences, challenges, and successes with technology integration. Finally, an observation protocol was developed to record classroom practices systematically, interactive tools, and levels of student engagement. These instruments were pilot-tested to ensure clarity, reliability, and validity (De Vaus, 2014).

3.6 Data Collection Methods

Data collection involved multiple techniques to ensure the comprehensiveness and reliability of the findings (Cresswell, 2018). Structured questionnaires were administered to teachers and students during regular school hours, with research assistants available to provide clarifications and ensure high response rates. Achievement tests were conducted in a controlled environment to maintain consistency and authenticity in student responses. Semi-structured interviews were conducted face-to-face, allowing participants to elaborate on their experiences and providing rich, contextual data. Classroom observations were conducted unobtrusively to capture natural teaching and learning dynamics. Detailed field notes complemented the observation data, providing additional context. Combining these methods ensured a robust dataset, as Creswell (2018) advocated, for both quantitative and qualitative analyses.

3.7 Analysis and Presentation of Data

Data analysis used quantitative and qualitative techniques to provide a well-rounded understanding of the research problem. Quantitative data from questionnaires and achievement exercises were analyzed using descriptive statistics such as means, frequencies, and percentages to identify trends. Qualitative data from interviews and observations were analyzed thematically. The thematic analysis involved coding and categorizing data into recurring themes, such as challenges in technology integration, student engagement, and teacher training needs. Triangulation of data from multiple sources was conducted to enhance the validity and reliability of the findings, ensuring a comprehensive interpretation of the results (Patton, 2015).

3.8 Ethical Considerations

Ethical principles guided every stage of the study to protect participants' rights and ensure the integrity of the research process. Through an informed consent process, participants were provided with detailed information about the study's purpose, procedures, and their rights. They were assured of the voluntary nature of their participation and their right to withdraw at any stage without repercussions. Anonymity and confidentiality were strictly maintained, with pseudonyms used in place of participants' real names. Data were securely stored in password-protected files accessible only to the research team. Ethical approval was obtained from the relevant institutional review board, aligning with the ethical guidelines outlined by Creswell (2018) for educational research.

3.9 Measures Taken to Minimize Errors

Several measures were implemented to minimize errors and enhance the reliability and validity of the findings. Pilot testing of the research instruments was conducted with a small sample to identify ambiguities and refine the questions for clarity and relevance. Data validation procedures included cross-checking completed questionnaires for consistency and completeness during and after data collection. Rigorous data cleaning processes were carried out to address missing values and identify outliers, ensuring the accuracy of the dataset. Research assistants received extensive training to standardize the administration of questionnaires, tests, and interviews, minimizing variability in data collection. These measures, as recommended by Babbie (2017), were critical to ensuring the credibility and dependability of the research findings.

3.10 Chapter Summary

This chapter has detailed the research methodology, including the design, sampling strategy, data collection methods, research instruments, ethical considerations, and measures to ensure reliability and validity. Using a mixed-methods approach combining quantitative and qualitative data ensures a comprehensive analysis of the integration of interactive technology in mathematics education in the Chegutu District. Ethical principles and rigorous methodological practices further strengthen the study's credibility. The subsequent chapter will present the analysis and interpretation of the data collected, offering insights into the current state, challenges, and impact of interactive technology in mathematics education.

CHAPTER IV: DATA ANALYSIS AND PRESENTATION

4.1 Introduction

This chapter provides a detailed analysis and interpretation of data collected during the study, which explored the integration of interactive technology in teaching ordinary-level mathematics in the Chegutu District. The findings are derived from quantitative and qualitative data collected through surveys, interviews, classroom observations, and achievement tests. These diverse methods ensured a comprehensive examination of the research questions. The analysis focuses on evaluating the current state of interactive technology integration in classrooms, identifying the challenges educators and students face, and assessing the impact of these technologies on teaching effectiveness, student engagement, and academic outcomes. By triangulating the data from different sources, the study offers nuanced insights into how interactive technology is utilized, its benefits, and the barriers to its widespread adoption. The findings provide a balanced perspective on the potential and limitations of technology-enhanced mathematics education, serving as a foundation for informed recommendations and future research directions.

4.2 Quantitative Data Analysis

The quantitative data collected from teachers and students were analyzed using descriptive statistical methods, including means, frequencies, and percentages. These statistical tools provided an in-depth summary of the extent to which interactive technology is utilized in classrooms and highlighted its correlation with student performance improvements. The analysis revealed patterns and trends in technology adoption, identifying the proportion of teachers actively integrating these tools and the frequency of their use. Furthermore, the statistical findings demonstrated a strong positive relationship between adopting interactive technology and measurable improvements in student engagement, comprehension, and overall academic performance in mathematics. This systematic analysis forms a critical part of understanding the practical impact of technology on teaching and learning outcomes.

Teacher Utilization of Interactive Technology

The population of mathematics teachers at Masawi Secondary School was four (4) and the study sample of three (3) teachers revealed that 67% of the teachers reported using interactive technology in their mathematics lessons. This significant majority indicates growing adoption rates, though challenges persist. Of the three (3) surveyed teachers, two (2) actively incorporated technology into their teaching practices, while one (1) reported minimal or no use of such tools. This variation highlights educators' disparities in technology access, skills, or preferences.

STUDENT ACHIEVEMENT

The survey data presented in Table 4.1 below provide an insight into the impact of interactive technology on mathematics performance, comparing the outcomes for male and female students. Pre-exercise was given using traditional method.

Table 4.1: Student Achievement

Category	**Frequency**	**Males**	**Females**	**Percentage**
Total Surveyed	20	10	10	100%
Improvement	18	8	10	80%
No improvement	2	2	0	20%

Learners were put in groups of 4 which consisted of two boys and two girls to complete an exercise with ten questions and their results were as follows. Only two groups had average marks which are group D and group E as indicated in table 4.2 below and the rest failed. This imply that out of the twenty (20) students sampled, twelve (12) failed the exercise because of the method of instruction used hence tried to use ICT tools to teach and give the post test.

Table 4.2: Pre-exercise results

Group	A	B	C	D	E
Results	3	4	1	6	5

After the pre-test learners was taught, the same concept using interactive technology and were given a post exercise. Learners completed the same exercise in pairs and only two boys failed the exercise while the rest passed. The pairing was done randomly using “yes” or “no” cards. The post-exercise results are as shown on the table below.

Table 4.3: Post exercise results

Group	A	B	C	D	E	F	G	H	I	J
Results	5	8	7	6	3	7	5	8	8	7

Student Achievement

The introduction of interactive technology in mathematics classrooms significantly impacted student achievement (Mishra et'al 2016). Out of 20 students surveyed, 80% demonstrated improved performance in mathematics after exposure to technology-enhanced teaching methods. These were distributed as 8 males and 10 females. Twenty percent (20%) of the students who did not get access to interactive technology indicated that Mathematics was a difficult subject. All these were males. The data suggest those that are taught using interactive technology, 3 males and 5 females, a total of 8 showed great improvement whereas the remaining 20% who are males showed no improvement at all. ICT tools enable students to grasp mathematical concepts more effectively, engage actively in lessons, and enhance their problem-solving skills, (Chagwiza and Mutambara, 2020).

Table 4.4: Teachers adopting interactive technology

Category	**Frequency**	**Males**	**Females**	**Percentage**
Surveyed Teachers	**3**	**1**	**2**	**100%**
Interactive Technology	**2**	**1**	**1**	**67%**
Not Using Interactive Technology	**1**	**1**	**0**	**33%**

The data gathered involved three (3) sampled teachers indicated that two (2) of the teachers representing is 67% of the sample used interactive technology. This included one female teacher who had 12 years of teaching experience and a male teacher who had 8 years teaching experience. Those that used interactive technology reported higher levels of student engagement and better concept understanding. These indicated the potential of these tools to improve teaching efficacy as reiterated by (Chagwiza & Mutambara, 2019). However, the remaining 33% of those who did not use technology cited lack of access, training, or technical support as the primary barriers.

4.3 Qualitative Data Analysis

Interview questions

The qualitative data, derived from teacher interviews were analysed. Key themes identified teacher motivation and infrastructural challenges. The purpose of an interview is to gain a deeper understanding of the respondent's thoughts, feelings, and experiences, and to gather rich, detailed data that can be used to develop theory or to explore a particular phenomenon, (Creswell, 2018).

Section A

Response 1: The participant was a *female teacher who had 24 years of teaching experience and held a certificate in Mathematics* teaching.

Response 2: The respondent was an *eight-year old male teaching-experienced teacher who was in possession of a Masters in Mathematics obtained at Bindura University of Science Education*. He indicated that *Mathematics was a good subject and inspired learners to grasp the concepts*.

Response 3: The participant was a *female who had twelve years teaching experience and had a first degree obtained at Bindura University of Science Education*. From my observation she is a very committed teacher.

Section B

Response 1: The *24-year old female teacher indicated that she was not well-versed to teaching mathematics using interactive technology. She was rather adamant on whether she used it in teaching it even though she rarely used her phone to give homework to learners*.

Response 2: The female teacher reported *being motivated to use technology in their teaching due to its potential to enhance student engagement and understanding. Additionally, teachers reported being motivated by the need to prepare students for a technology-driven future*.

Response 3: The male teacher *reported integrating technology into their mathematics lessons through the use of digital tools, such as maths software and online resources*. Moreover, *teachers also reported using interactive whiteboards and educational apps* to enhance student engagement and participation.

Section C

Response 1: The teacher reported *assessing the effectiveness of technology in enhancing student learning through observations, quizzes and tests*. The teacher also reported using *student feedback and self-assessment to evaluate the effectiveness of technology*. She reported facing challenges such as *technical issues, lack of training and limited access to technology*.

Response 2: Teacher reported *addressing these challenges through training and acquiring technical support, attending training sessions and exploring alternative technologies*. Apart from that, the teacher also reported that *technology has had a positive impact on student engagement and participation in mathematics lessons*.

Response 3: The teacher reported *noticing improvements in student understanding and achievement since integrating technology into their teaching practices*.

Section D

Response 1: The female teacher reported that she *envision technology continuing to play a critical role in mathematics education.*

Response 2: The male teacher reported *believing that technology should be used to support teaching and learning, rather than replace traditional methods*.

Response 3: The teacher reported that *if teachers get knowledge from staff development, interactive technology can produce good results in Ordinary level mathematics.*

Furthermore, the interviewee revealed that *the teacher believes that technology has the potential to enhance student engagement, understanding and achievement in mathematics*. However, teachers also reported facing challenges in integrating technology into their teaching practices. The findings suggest that teachers need training, support and resources to effectively integrate technology into their teaching practices**.**

The data has shown that those teachers with higher level of education could effectively use technology to produce good results. The level of education of teachers can have a significant impact on their ability to effectively teach ordinary level mathematics using interactive technology. Teachers with higher levels of education, such as bachelor's or master's degrees, may be better equipped to integrate technology into their teaching practices.Research has shown that teachers with higher levels of education tend to be more effective in the classroom (Darling-Hammond, 2000). This is because they have received more training and education on how to teach and integrate technology into their lessons. For example, a study by the National Center for Education Statistics (2019) found that teachers with master's degrees were more likely to use technology in their classrooms than teachers with bachelor's degrees.

The researcher has also observed that, while experienced teachers may have a deep understanding of mathematical concepts and pedagogy, a lack of knowledge on utilizing technology can hinder their ability to engage students and promote deeper learning. For example, a study by the National Center for Education Statistics (2019) found that teachers who were not proficient in using technology reported lower levels of student engagement and motivation.

In contrast, teachers who are knowledgeable about technology can leverage its potential to enhance mathematics instruction (Lavicza, 2019). For instance, interactive whiteboards, educational software, and online resources can facilitate interactive and collaborative learning, promote visualization and exploration of mathematical concepts, and provide real-time feedback and assessment.

The findings of this study highlight the need for teacher professional development programs to prioritize technology training and support. This may include providing workshops, coaching, and mentoring opportunities to help teachers develop the skills and confidence they need to effectively integrate technology into their teaching practices.

Increased Student Enthusiasm

The qualitative data analysis revealed that the use of interactive technology in mathematics lessons led to increased student enthusiasm and engagement. This theme emerged from the responses of both teachers and students who participated in the study.

Teacher Perspectives

The teachers who participated in the study reported that the use of interactive technology in mathematics lessons led to increased student enthusiasm and engagement. For example, one teacher noted, "Since I started using interactive technology in my mathematics lessons, I have noticed a significant increase in student enthusiasm and engagement. Students are more motivated to learn and participate in class discussions. "The students who participated in the study also reported increased enthusiasm and engagement in mathematics lessons when interactive technology was used. For example, one student noted, "I used to hate mathematics, but since our teacher started using interactive technology in class, I have started to enjoy it. The lessons are more fun and interactive, and I feel more motivated to learn."

Teacher Motivation and Challenges

While many teachers expressed enthusiasm for using technology, they also highlighted significant challenges, including limited access to reliable infrastructure, lack of professional training, and insufficient technical support. One teacher remarked, "I see the potential of these tools, but without proper training and support, it's difficult to use them effectively."

Infrastructure and Technical Limitations

Classroom observations revealed that some schools struggled with outdated equipment, poor internet connectivity, and a lack of technical support. These limitations hinder the effective integration of technology and reduce its potential impact on student outcomes.

4.4 Data Triangulation

The combination of quantitative and qualitative findings provides a holistic understanding of the role of interactive technology in mathematics education. Quantitative data highlight the correlation between use and improved student performance, while qualitative insights reveal technology teachers' challenges in leveraging these tools. For instance, 67% of teachers reported using technology, but qualitative data show that many struggled with infrastructural constraints, emphasizing the need for targeted interventions to address these barriers.

4.5 Summary of Findings

The research identified several critical findings:

1. **Positive Implications for Teaching and Learning**: Interactive technology significantly improves teaching practices and student outcomes. With 75% of teachers using technology, 80% of students reported better performance in mathematics, showcasing the educational benefits of these tools.
2. **Challenges in Integration**: Teachers face substantial challenges, including limited access to resources, insufficient training, and technical difficulties, which hinder the full potential of technology-enhanced education.

3. **Need for Professional Support and Infrastructure Development**: The findings highlight the urgent need for professional development programs and investments in infrastructure to ensure the effective use of interactive technology in schools.

4.6 Implications for Practice

The findings underscore several actionable recommendations to optimize the integration of interactive technology in mathematics education:

1. **Teacher Training and Support**: Comprehensive training programs should equip teachers with the skills and confidence to use technology effectively. These programs should include practical workshops and ongoing mentorship.
2. **Infrastructure Development**: Significant investment in infrastructure, including reliable internet connectivity and up-to-date hardware, is essential to support the seamless integration of technology in classrooms.
3. **Curriculum Alignment**: The mathematics curriculum should be reviewed and revised to incorporate interactive tools, ensuring that technology complements and enhances learning objectives.
4. **Policy Support**: Policymakers should prioritize funding for technology in education and establish partnerships with NGOs and private sector stakeholders to address resource gaps.

4.7 Summary

This chapter provides an in-depth analysis of the data collected to explore the role of interactive technology in enhancing ordinary-level mathematics teaching in the Chegutu District. The findings demonstrate that integrating technology has significant potential to transform mathematics education by improving student engagement, performance, and critical thinking skills. Quantitative data reveal that most teachers use interactive tools in their lessons, which correlate strongly with improved student achievement. Similarly, qualitative insights shed light on the enthusiasm of educators and students alike for technology-enhanced learning despite notable challenges.

The study identified critical barriers to the effective integration of interactive technology, including infrastructural limitations, lack of professional development, and inadequate technical support. These obstacles highlight the need for strategic interventions to ensure that the full potential of technology can be realized. By addressing these challenges through teacher training, resource allocation, and curriculum alignment, policymakers and educators can create an enabling environment for interactive technology to thrive. Ultimately, this chapter underscores the dual nature of interactive technology in mathematics education: it is both a powerful tool for improving learning outcomes and a challenge requiring significant infrastructure and training investments. The next chapter will build on these findings to discuss their broader implications, draw conclusions, and offer practical recommendations for policymakers, educators, and stakeholders in Zimbabwe's education sector. This holistic approach aims to bridge the gap between potential and practice, ensuring that technology catalyses transformative change in mathematics education.

CHAPTER V: DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Introduction

This chapter delves into the implications of the findings presented in Chapter Four regarding the integration of interactive technology in ordinary-level mathematics education within the Chegutu District. It synthesizes the quantitative and qualitative data collected during the study to comprehensively analyze the challenges, successes, and future possibilities for technology-enhanced education. Furthermore, actionable recommendations are proposed to address the identified barriers and optimize the use of interactive tools. The chapter concludes with reflections on the study's contributions and areas for further research.

5.2 Discussion of Findings

The findings from this study underscore the transformative potential of interactive technology in mathematics education while revealing significant challenges that hinder its full integration.

Quantitative data highlighted that 67% of teachers actively incorporate interactive technology into their teaching practices. This widespread usage aligns with the observed 80% improvement in student performance, indicating that technology can significantly enhance student learning outcomes. These findings align with previous research by Cheung and Ng (2015), which noted that students utilizing technology-enhanced learning tools performed better in mathematics than their peers relying solely on traditional methods.

Despite these promising outcomes, qualitative data revealed underlying challenges that impede effective integration. Teachers expressed frustration with infrastructural limitations, such as unreliable internet connectivity and inadequate access to digital devices. Moreover, many educators highlighted the need for professional development programs to equip them with the skills to leverage technology effectively. This is consistent with Ottenbreit-Leftwich et al. (2010), who emphasized that a lack of training is a significant barrier to successful technology adoption in classrooms.

Additionally, the thematic analysis revealed that teachers and students find interactive tools motivating and engaging. Teachers reported increased enthusiasm in their classrooms, while students demonstrated greater participation and curiosity during technology lessons. However, technical issues and the lack of institutional support were recurring concerns. These findings suggest that while there is enthusiasm for using technology, systemic and logistical barriers must be addressed to maximize its impact.

5.3 Conclusions

The study concludes that integrating interactive technology into ordinary-level mathematics teaching in the Chegutu District substantially benefits teaching and learning. The high adoption rate among teachers and the notable improvement in student performance underscore the effectiveness of these tools in enhancing educational outcomes. Furthermore, the strong correlation between technology use and student engagement highlights the potential of interactive tools to make learning more dynamic and participatory.

However, the study also identifies critical challenges, including infrastructural deficiencies, limited resource access, and insufficient teacher training. These barriers underscore the need for a holistic approach that combines technological investments, professional development and institutional support. Addressing these challenges is essential to ensuring that the benefits of interactive technology are fully realized in mathematics education.

The study also emphasizes the importance of aligning interactive tools with curriculum objectives and creating a supportive environment for their implementation. Without targeted interventions to address these challenges, the full potential of technology-enhanced education may remain unrealized.

5.4 Recommendations

Teacher Training and Support:

To effectively integrate interactive technology into mathematics education, there must be a significant emphasis on professional development for teachers. Comprehensive and continuous training programs should be developed to enhance teachers' confidence and competence in utilizing interactive technology. These programs should cover the technical aspects of digital tools and pedagogical strategies to integrate them into the mathematics curriculum seamlessly. Teachers need practical, hands-on workshops and long-term mentorship opportunities to internalize and fully apply these skills in their classrooms. Moreover, creating resource-sharing platforms where educators can access teaching materials, share innovative practices, and provide peer support will enhance the collective capacity to use technology effectively. Teachers who are well-supported through ongoing training and mentorship are more likely to overcome technical challenges and maximize the potential of interactive tools to engage students.

Infrastructure Development:

The successful integration of interactive technology in schools depends heavily on robust infrastructure. Many schools, particularly in rural areas like Chegutu District, lack reliable internet connectivity, sufficient hardware, and technical support, hindering interactive technology's practical use. Investments in infrastructure are urgently needed to provide schools with the tools and resources required for technology-enhanced education. Government agencies, non-governmental organizations, and private sector partners should collaborate to fund and implement infrastructure development projects. For example, partnerships with telecommunications companies could ensure affordable and consistent internet access, while grants from education-focused NGOs could help schools acquire modern devices and software. Establishing technical support systems within schools is equally important, as they ensure that educators and students can rely on the tools without disruptions caused by technical malfunctions. With adequate infrastructure, interactive technology can be seamlessly integrated into classrooms, enabling teachers and students to focus on learning rather than logistical challenges.

Curriculum Alignment:

For interactive technology to be effective, it must be integrated into the mathematics curriculum purposefully and meaningfully. A thorough review and revision of the current curriculum must incorporate interactive technology explicitly. This process should involve designing activities, lessons, and assessments that leverage digital tools to enhance conceptual understanding, problem-solving skills, and critical thinking. For instance, interactive tools like graphing software, dynamic geometry tools, and simulation platforms can be embedded into lessons to make abstract mathematical concepts more tangible and engaging for students. Furthermore, curriculum developers should ensure that these activities align with national education standards and learning goals, emphasizing the use of technology and its role in improving student outcomes. By aligning technology with curriculum objectives, schools can ensure its use goes beyond novelty, becoming an integral part of the teaching and learning process that enhances educational outcomes.

Monitoring and Evaluation:

The integration of interactive technology in education must be accompanied by regular monitoring and evaluation mechanisms to measure its effectiveness and guide continuous improvement. Schools should implement systematic feedback loops involving teachers, students, and administrators to assess the strengths and weaknesses of technology-enhanced teaching practices. Metrics such as student performance, engagement levels, and teacher satisfaction can provide valuable insights into the impact of interactive tools on mathematics education. Additionally, monitoring tools should evaluate the accessibility and usability of technology, identifying any barriers teachers and students may encounter. For example, schools could use performance-tracking systems to measure changes in student achievement after introducing interactive technology or conduct periodic surveys to gauge teacher and student experiences. These insights can inform targeted interventions and adaptations, ensuring that technology integration remains relevant, effective, and aligned with educational objectives.

Policy Development:

To create an enabling environment for the integration of interactive technology, education policymakers must develop comprehensive guidelines and frameworks. These policies should address critical areas such as resource allocation, teacher training, and infrastructure development to ensure a holistic approach to technology adoption. Policymakers should prioritize funding for schools in resource-constrained areas to bridge the digital divide and promote equitable access to interactive tools. Clear standards for teacher competencies in technology use should also be established, accompanied by incentives for professional development and innovation in teaching practices. Additionally, policies should encourage partnerships with private sector organizations and NGOs to mobilize resources and expertise for technology integration. By creating a policy framework that supports interactive technology at all levels—from classrooms to national education systems, stakeholders can ensure that these tools effectively transform mathematics education and empower students for the future.

In conclusion, the above recommendations emphasize the need for a multifaceted approach to integrating interactive technology in mathematics education. By investing in teacher training, infrastructure, curriculum alignment, monitoring, and supportive policies, schools can overcome existing challenges and fully leverage the benefits of interactive tools to improve student learning outcomes. These efforts require collaboration among educators, policymakers, and community stakeholders to create a sustainable and inclusive model for technology-enhanced education.

5.5 Implications for Future Research

Future research should explore the long-term impact of interactive technology on student performance and attitudes. Studies could investigate how specific tools influence learning outcomes across mathematical topics or educational levels. Additionally, research on the effectiveness of various teacher training models could provide valuable insights into best practices for professional development.

Comparative studies across urban and rural settings would also be beneficial in understanding the unique challenges and opportunities in different contexts. Finally, research on the costeffectiveness of various technological interventions could guide resource allocation and decision-making processes.

5.6 Conclusion

This chapter highlights the transformative potential of interactive technology in enhancing mathematics education while acknowledging the significant barriers to its integration. The findings underscore the need for targeted investments in infrastructure, teacher training, and curriculum alignment to realize the benefits of these tools entirely. By addressing these challenges, stakeholders can create a supportive, inclusive educational environment that empowers teachers and students.

The study contributes to the growing knowledge of technology-enhanced education and provides actionable recommendations for policymakers, educators, and researchers. With sustained efforts and strategic interventions, interactive technology can revolutionize mathematics education in the Chegutu District, preparing students for the demands of the modern world.

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APPENDIX

Appendix A: Survey Questionnaire (Mathematics Teachers)

Section A: Demographics

1. Gender (optional)
2. School Name
3. Teaching Experience (years)
4. Qualifications (degree/certificate)

Section B: Technology Acceptance *(Adapted from Technology Acceptance Model - TAM)*

1. How often do you use technology in your mathematics lessons?
    - Daily
    - Weekly
    - Monthly
    - Rarely
2. How easy is it to use technology in your mathematics lessons?
    - Very easy
    - Easy
    - Neutral
    - Difficult
    - Very difficult
3. Do you believe technology enhances mathematics teaching?
    - Strongly agree
    - Agree
    - Neutral
    - Disagree
    - Strongly disagree

Section C: Technology Integration

1. What types of technology do you use in mathematics lessons? *(Check all that apply)*

- Interactive whiteboards
- Computers/tablets
- Mobile devices
- Educational software
- Online resources

2. How do you primarily use technology in mathematics lessons? *(Check all that apply)*
   - Presentations
   - Practice exercises
   - Games/simulations
   - Collaborative work
   - Assessments

Section D: Challenges and Support

1. What challenges do you face when using technology in mathematics lessons? *(Check all that apply)*
   - Technical issues
   - Limited resources
   - Lack of training
   - Student distraction
   - Other (please specify)
2. Have you received training on using technology in mathematics teaching?
   - Yes
   - No

Achievement Test (Ordinary Level Mathematics Students)

Section A: Multiple Choice Questions *(20 questions covering various mathematics topics)*

Section B: Open-Ended Questions *(5 questions assessing problem-solving and critical thinking)*

Appendix B: Interview Questions (Mathematics Teachers)

Introduction:

Briefly introduce yourself and your teaching experience.

Section A: Technology Integration

1. Can you describe how you integrate technology into your mathematics lessons?
2. What motivated you to start using technology in your teaching?
3. How do you assess the effectiveness of technology in enhancing student learning?

Section B: Challenges and Support

1. What challenges have you faced when implementing technology in your mathematics lessons?
2. How have you addressed these challenges?
3. What support or resources would you like to receive to improve technology integration?

Section C: Student Engagement and Outcomes

1. How has technology impacted student engagement and participation in mathematics lessons?
2. Have you noticed any improvements in student understanding or achievement?
3. Are there any specific technology tools or resources that you find particularly effective?

Section D: Future Directions

1. How do you envision technology evolving in mathematics education?
2. What role should technology play in mathematics teaching?
3. Are there any innovative technologies or approaches you'd like to explore?

APPENDIX C

LESSON PLAN

Topic: Laws of Indices for Form Three (Ordinary Level) learners:

Lesson Topic: Laws of Indices

Objectives:

- ✓ Learners will understand the concept of indices and laws of indices.
- ✓ Learners will apply the laws of indices to simplify expressions.
- ✓ Learners will use technology to explore and visualize the laws of indices.

Materials:

1. Whiteboard and markers

2. Computers or tablets with internet access

3. Interactive math software (Desmos)

4. Worksheet with laws of indices exercises

Procedure:

Introduction (10 minutes)

1. Review the concept of indices and introduce the laws of indices.

2. Use the whiteboard to demonstrate how to apply the laws of indices.

Guided Practice (15 minutes)

1. Provide learners with a worksheet containing laws of indices exercises.

2. Have learners work in pairs to simplify expressions using the laws of indices.

3. Circulate around the room to assist and provide feedback.

Technology Integration (20 minutes)

1. Introduce interactive math software (e.g., GeoGebra, Desmos).

2. Demonstrate how to use the software to explore and visualize the laws of indices.

3. Have learners work individually to simplify expressions using the software.

Independent Practice (15 minutes)

1. Provide learners with a new set of laws of indices exercises.

2. Have learners work individually to simplify expressions using technology.

Assessment (10 minutes)

1. Review learner worksheets and technology output for accuracy.

2. Provide feedback and encouragement.

APPENDIX D: **Questions for laws of indices using Interactive Technology**

1. Simplify: $2^3 \times 2^4$

2. Simplify: $3^2 \div 3^5$

3. Simplify: $(2^3)^4$

4. Simplify: $5^2 \times 5^6$

5. Simplify: $2^8 \div 2^3$

6. Simplify: $(3^2)^5$

7. Simplify: $4^3 \times 4^2$

8. Simplify: $2^9 \div 2^6$

9. Simplify: $(5^3)^2$

10. Simplify: $3^4 \times 3^7$