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PROJECT TITLE: AN INVESTIGATION ON THE USE OF SMARTPHONES IN THE TEACHING AND LEARNING OF VECTORS AT ORDINARY LEVEL. A CASE OF SELECTED SECONDARY SCHOOLS IN MWENEZI DISTRICT.

BY

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DEDICATION

This research project is dedicated to my wife ,my sons and my brother for all the support throughout the study. Without their encouragement, this work would have been next to impossible to accomplish.

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Most importantly, I offer my earnest gratitude to the creator, my God, for guiding and protecting me throughout the entire process of my learning at this degree level. I also dedicate my sincere acknowledgement with gratitude to the critical role played by my Supervisor, Mr I. Gwizangwe for his priceless help and guidance through inspiration and encouragement during all stages of the study. He gave me constant support and motivation with patience to remain focused. I would like to offer special thanks to my wife Dzinavene Alpha , my sons Paraclete Manyetu and Paraenetical Manyetu and my brother Jephison Manyethu for being my inspiration, providing unceasing encouragement, attention, financial and emotional support throughout the course. I also dedicate my sincere acknowledgements to the head, teachers and learners for their cooperation and assistance given during the application of the research instruments.

ABSTRACT

The study sought to investigate the the use of smartphones in the teaching and learning of vectors at ordinary level school in Mwenezi district the major case being a case of selected Secondary School. The objectives of the study were to to determine the extent to which Mathematics teachers incorporate the use of smart phones in their teaching models, to ascertain the importance of smart phones in the teaching and learning of vectors at Ordinary level, to establish the challenges that are encountered in trying to incorporate the use of smart phones in the teaching and learning of vectors. It was from these objectives that the researcher managed to come up with research questions. The research is significant to selected Secondary School, Ministry of Primary and Secondary Education, teachers, parents, learners and future researchers. Literature review was guided by the research objectives which formed most of the major subheadings and other major issues which were brought forward were the theoretical framework in this case the researcher used the Technological Pedagogical Content Knowledge (TPACK) framework, The researcher used mixed methodology approach that is incorporating both quantitative (use of questionnaires) and qualitative research designs (use of (interviews). A target population of 77 respondents was considered and from this target population the researcher noted that 32 people respondents. The researcher used purposive and stratified sampling to carry out this study. From the research findings the researcher noted that smartphones are being incorporated in the teaching and learning of vectors in secondary schools. The researcher noted that most of the students at selected Secondary school own smartphones researcher noted that smartphones are important in the teaching and learning of Mathematics (Vectors) as they enhance student engagement also helps in sharpening research skills of learners, The results also showed that smartphones are important as they make learning of mathematics interesting. However, despites the advantages of smartphones in the teaching and learning process the researcher also noted that integrating smartphones in the teaching and learning comes with challenges. Some of the challenges heighted included the lack of technological skills from mathematics teachers. Students are also destructed by smartphones as they tend to use social media during learning sessions. Shortage of smartphones to all learners, unavailability of policy guidelines by the school on the use of smartphones are some of the major challenges highlighted. The researcher concluded that smartphones are useful in the teaching and learning of vectors but it do have limitations. The researcher recommends that secondary schools should have guidelines on the use of

smartphones in the teaching and learning. There is need for schools to have both soft and hard infrastructure that supports the use of smartphones in the teaching and learning process.

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ABBREVIATIONS AND ACRONYMS

MOPSE – Ministry of Primary and Secondary Education

ICT – Information Communication Technology

TPACK- Technological Pedagogical Content Knowledge

SDA – School Development Association

MD– Mwenezi District

CHAPTER 1

INTRODUCTION

1.1 Introduction

This research seeks to investigate the use of smartphones in the teaching and learning of Vectors at Ordinary level. A Case of selected Secondary School in Mwenezi district. The chapter will consider the motivational factors that led the researcher to carry out this research. To be precise this chapter covers the background of the study, statement of the problem, significance of the study, objectives of the study to which the research questions will be derived. The chapter will also look at the delimitation and limitations of the study, the location and the definition of key terms.

1.2 Background of the study

Globally as ascertained by Sharp (2019) the second of information Communication Technology has become prominent in every secret including the educational sector. Educational institutions in Europe as believed by Henriksen etal (2019) have shifted from the traditional ways of teaching and learning to a more interactive one necessitated by the use of mobile phones. To Theo etal (2014) mobile phones have become people's daily lives including learners .Compared to the use of computers in the teaching and learning ,mobile phones have proved to be advantageous as they are portable and their ability to run different software's. Studies by Sharp (2019) indicated that in China learners have managed to leverage on the use of mobile phones both at home and at school to facilitate their learning process. Lee etal (2015) notes that besides the accessibility of mobile phones, they help in ensuring problem solving in real time. In the same vein Theo etal (2014) quoted Kinsella (2009) who developed an application for use in mathematics whereby he would sent tasks to learners who then would then perform the tasks and sent them back to the teacher who would also respond in real time.

Henriksen etal (2019) examined the use of mobile phones during the COVID 19 era and found out that mobile phones were one of the important tools that were use to ensure effective learning. With COVID 19 operating guidelines as prescribed by World Health Organisation schools were made to close and this meant that OK physical learning was now the thing of the past. Smartphones became a saviour which ensured continuity of the learning process. Adjei(2019) admitted that the introduction of smartphones have transformed ye teaching and

learning of developed nations while third world countries are also following suit. To Feanyi and Chukwuere (2018) the proliferation of the internet based learning has led to the greater use of mobile phones irrespective of the geographical location of learners. Fawareh and Jusoh (2017) admired how a smartphone is important in the teaching and learning processes as smartphones have reduced the use of digital cameras and videos as well as reduction in the use of paper work.

International Telecommunication Union, (2008) indicated that about 60% of the world's population has access to mobile phones. Sarfoah (2017) notes that smartphone a have increased its use in developing countries as almost everyone has mobile phones than developed countries. However they are innovatively used in developed countries than in developing countries. Adjei (2019) argued that in Africa, Malaysia is one of the countries which have almost 55% users of mobile phones. Quist and Quarshie, (2016) noted the research done by the World Bank whereby Ghana was placed number 14 on the countries that made use of mobile technology.

To Dhliwayo and Muchemwa (2017) Zimbabwe as a country has also incorporated the use of smartphone a mostly as a means of communication .Many organisations have tried to make use of smart phones in the learning process. It is key to note the strides made by companies like Ruzivo digital learning and others like Edutech. These organisations have embraced the use of ICT in the teaching and learning process. Dhliwayo and Muchemwa (2017) notes that though smart phones have high potential to change the educational landscape more needs to be done for learners and stakeholders to appreciate its use. The educational system in Zimbabwe are still clinging to the use of traditional methods of teaching thus prompting the researcher to investigate the use of smart phones in the teaching and learning of vectors at ordinary level.

1.3 Statement of the problem

While smartphones have the potential to revolutionize teaching and learning of vectors in Mathematics especially in rural areas, there integration into the educational landscape presents several problems that need to be carefully examined. Some of the problems which have come with the use of smart phones in the teaching and learning of vectors include limited accessibility, digital device, cyber bullying and destruction, effortless information access which leads to lack of critical thinking. This resonates well with the ideas by Margarita etal (2021) who notes that in most African countries the use of technology in the teaching and learning is still a challenge emanating from lack of skills from traditionally trained teachers and lack of internet in rural setups. There is also a problem of insufficient physical interaction

when learners make use of smartphones in teaching and learning of vectors at Ordinary level. Holtz. Etal (2018) also notes that smartphones lack physical touch.It is against this background that this research intends to investigate the use of smartphones in the teaching and learning of vectors at ordinary level.

1.4 Research Objectives

The objectives that are going to guide this research are

- To determine the extent to which Mathematics teachers incorporate the use of smart phones in their teaching models
- To ascertain the importance of smart phones in the teaching and learning of vectors at Ordinary level.
- To establish the challenges that are encountered in trying to incorporate the use of smart phones in the teaching and learning of vectors .
- To utilize mobile apps like Vector calculator or Mathway that provide interactive Vector calculations, visualization and simulation.

1.5 Research questions

- To what extent do mathematics teachers incorporate the use of smart phones in their teaching models?
- How important are smart phones in the teaching and learning of vectors at Ordinary level?
- Which challenges are encountered in trying to incorporate smartphones in the teaching and learning of Vectors in Mathematics?

1.6 Assumptions

There are several assumptions applicable to this research. Some of the teachers and learners at selected Secondary School are now using smartphones in the teaching and learning process. Learners and teachers at selected Secondary School do have challenges as far as the usage of smart phones in the teaching and learning is concerned. All respondents will be cooperative and respond in an unbiased manner. The researcher will get reliable information from the research from the respondents.

1.7 Significance of the Study

This research will be benefit the following stakeholders.

1.7.1 Selected Secondary School

It is the researcher's believe that the research will be of useful to selected Secondary School as it will come up with strategies which ensure the use of smartphones as a teaching media, source of material in the teaching and learning The school authorities will place both physical and soft infrastructure that enable the implementation of the use of smartphones in the teaching and learning process. The school and SDA will understand the importance of 21st century teaching media in learners' educational performance.

1.7.2 Researchers

This study will be significant in helping researchers as it will be a source of reference in writing their journals and e-books. It will therefor help future researchers. This research will be of great use in sharpening the research skills of learners.

1.7.3Teachers

It is the belief of the researcher that this research will help mathematics teachers to incorporate the use of smartphones in the teaching and learning of vectors. Teachers will be able to use smartphones as an interactive tool in the teaching and learning of vectors.

1.7.4 Parents

The study will help parents to be proactive and to purchase smartphones and data for their children to use them in the teaching and learning of vectors in mathematics.

1.7.5 Learners

This research will help mathematics student to understand the topic to do with vectors. The learners can make use of smartphones to send videos and audios to the teacher as well as to receive the same from teachers. The learners will appreciate the benefit of using smartphones in the learning of vectors in Mathematics

1.7.6 Ministry of Primary and Secondary Education

The ministry will be able to review their policies on digital learning and use of ICT. It can make the use of smartphones compulsory in learning of vectors in mathematics. If this learning becomes compulsory the parents will support by purchasing the gadgets for learners. The ministry as government representative will help by installing electricity and solar powered electricity to complement the use of ICT. The ministry will also support by recruiting mathematics teachers in schools who have knowledge in teaching and learning of ICT

1.8 Limitations of the Study

It is common knowledge that the views and perceptions of Mathematics teachers may not reflect what is happening, they may give false reports which will then jeopardize the research. To mitigate this the researcher will ask different respondents like learners and then compare the results. Observations will also be carried out to have personal information on whether learners are using smartphones in mathematics lessons or not. Some information may be regarded as confidential and may not be divulged to the researcher. To mitigate this the researcher will not divulge the names of the respondents. Some respondents may not be willing to complete the questionnaires due to other commitments and time constraints. Therefore for the researcher to have a high response rate he will collect the questionnaires at the time when the respondents will be free to avoid interrupting their work. Reliability may be at threat since there is high probability that some respondents would complete the questionnaires for the sack of getting rid of what they call unrewarding process. However the researcher will patiently explain to the respondents some of the ethics he expects from them.

1.9 Delimitations

According to Chambers (2021), delimitations refer to the boundary of the study. He further states that the study is delimited in terms of the concept, geographical area, population and period. Using Chambers' (2021) recommendations, the study will be delimited to the concept of the use of ICT that is the use of smartphones in the teaching and learning of Vectors in the teaching and learning of Mathematics. In addition, the study time delimits the study from 2019 to 2024.In terms of geographical boundary the research will be confined to Ordinary Level learners at selected Secondary School which is in Mwenezi district.

1.10 Location of the study

A school is located in the Masvingo Province in Mwenezi District. The school is located in Rutenga Growth point just after Lundi coming from Ngundu to Beitbridge highway .The school is in the Growth Point under the Headman Mr Sithole in Chief Neshuro. Economically there is a lot of economic activities normally marula production as the district falls within the Marula Factory though agriculture is practiced at a low scale. Some of the common telecommunication service providers are Netone while Econet do have limited service. Telecel is a very big challenge in the area. Most of the families are low income families who rely on hand to month.

1.11 Definition of key terms

Teaching

Rajagopalan (2019) defined teaching as “an interactive process, primarily involving classroom talk which takes place between teacher and pupil and occurs during certain definable activities”.

Learning

Adjei (2019) defines learning as a lifelong process done at formal and informal institutions. He notes that learning is all about knowledge acquisition.

Smartphones

Whyte (2019) defined a smartphone is a mobile phone that performs many of the functions of a computer, typically having a touchscreen interface, Internet access, and an operating system capable of running downloaded apps.

Vector

Barata and Cunha (2022) defined a vector is a quantity that has both a magnitude (and size) and a direction. Both of these properties must be given in order to specify a vector completely.

1.12 Chapter Summary

This chapter introduced the background to the study, statement of the problem, research questions and significance of the study. It also discussed delimitations and limitations of the study and definition of key terms. The next chapter will review international and Zimbabwean literature related to impact of the use of smartphones in the teaching and learning of Vectors at Ordinary Level.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.0 Introduction

In the dynamic landscape of education, technology integration has emerged as a central focus for improving teaching methods and student learning. This chapter provides a comprehensive review of existing literature on the use of smartphones in educational settings, with a focus on their application in the teaching and learning of vectors in secondary schools. As smartphones and mobile technology become increasingly prevalent, scholars have explored how these devices can support personalized learning, interactive simulations, and collaborative activities, thereby enhancing student engagement and understanding of mathematical concepts. The chapter discusses the potential benefits of smartphones, such as access to multimedia resources and dynamic learning environments, which can aid in the visualization and application of vector concepts. It also addresses the challenges associated with smartphone use in education, including distractions, equity issues, technical constraints, and concerns around privacy and security. By examining proposed strategies to navigate these challenges, the chapter presents a balanced view of the opportunities and obstacles presented by smartphones in vector education. This literature review sets the stage for the investigation into Secondary Schools, emphasizing the need for localized research on smartphone use in vector education and its impact on students' learning experiences.

2.1 ICT in Mathematics Education

The integration of Information and Communication Technology (ICT) in mathematics education has been a subject of extensive research and scholarly inquiry. Scholars such as Kumar,V.S. (2021) have delved into the transformative impact of ICT tools on pedagogical practices and student learning outcomes in mathematics classrooms. Balacheff's work emphasizes the dynamic interplay between technology and pedagogy, highlighting how ICT facilitates interactive and exploratory approaches to learning mathematics. By providing students with access to digital resources, simulations, and interactive software, ICT supports constructivist pedagogical frameworks, where learners actively construct their understanding of mathematical concepts.

Moreover, Hoyles et al. (2010) conducted a comprehensive review of research on ICT in mathematics education, shedding light on the diverse range of technologies used in classrooms

and their implications for teaching and learning. Their findings underscore the multifaceted nature of ICT integration, ranging from basic tools such as graphing calculators to more advanced software applications for dynamic geometry and mathematical modeling. Through empirical studies and classroom observations, they documented the positive impact of ICT on student engagement, problem-solving skills, and conceptual understanding across various mathematical topics.

Building upon these insights, Makondo ,V and Makondo,D.(2020) explored the integration of computer-based learning environments in teaching algebraic concepts. Their research demonstrated the effectiveness of digital platforms in scaffolding students' algebraic reasoning skills and facilitating interactive problem-solving activities. By providing feedback, hints, and adaptive support, computer-based environments promote self-directed learning and enable students to explore mathematical concepts at their own pace. Similarly, Ruthven et al. (2009) focused on the pedagogical affordances of ICT tools for promoting mathematical inquiry and exploration. Through case studies and classroom interventions, they highlighted the role of technology in fostering collaborative problem-solving, mathematical discourse, and reflective thinking among students.

Furthermore, Sinclair et al. (2016) investigated the use of online professional learning communities to support mathematics teachers in integrating technology into their instructional practices. Their research highlighted the importance of collaborative platforms for teacher professional development, where educators can share resources, exchange ideas, and engage in reflective dialogue about their teaching experiences. By fostering a culture of collaboration and continuous learning, online communities empower teachers to leverage ICT effectively to enhance student learning outcomes.

Similarly, Watson (2018) explored the role of teacher beliefs and attitudes in shaping the implementation of ICT in mathematics classrooms. Through surveys and qualitative interviews, he identified factors such as teacher efficacy, technological pedagogical content knowledge (TPACK), and institutional support as critical determinants of successful ICT integration. Teachers' beliefs about the value of technology, their confidence in using ICT tools, and their perceptions of administrative support influence the extent to which ICT is incorporated into instructional practices. Thus, understanding and addressing teachers' beliefs and attitudes are essential for promoting sustainable and meaningful ICT integration in mathematics education.

The existing literature on the integration of Information and Communication Technology (ICT) in mathematics education offers valuable insights into its transformative potential; however, a significant research gap exists concerning the specific utilization of smartphones in teaching and learning vectors at the secondary school level. While studies by scholars such as Balacheff, Hoyles, Leung, Ruthven, Sinclair, and Watson have explored various ICT tools and pedagogical approaches in mathematics education, they primarily focus on computers, online platforms, and digital learning environments, neglecting the unique features and affordances of smartphones. Therefore, there is a pressing need for empirical research that specifically investigates how smartphones can effectively enhance vector instruction, considering factors such as accessibility, usability, and pedagogical impact within the School. Additionally, limited attention has been given to understanding teachers' perceptions, attitudes, and challenges related to incorporating smartphones into vector education, highlighting the importance of addressing these factors to support sustainable integration efforts and inform evidence-based practices tailored to the needs of the School.

2.2 Theoretical framework: Technological Pedagogical Content Knowledge (TPACK) framework,

The Technological Pedagogical Content Knowledge (TPACK) framework, proposed by Mupam.P,(2015) offers a comprehensive theoretical lens through which educators can navigate the complexities of integrating technology into teaching and learning contexts. Drawing upon TPACK, educators can address the challenges associated with smartphone use in vector education while maximizing the potential for meaningful learning experiences.

Scholars such as Angeli and Valanides (2009) have expanded upon the TPACK framework by emphasizing the dynamic interplay between technological, pedagogical, and content knowledge domains. Their research highlights the iterative nature of TPACK development, emphasizing the need for ongoing reflection, experimentation, and adaptation in response to changing educational contexts and technological advancements. By embracing a growth mindset and a commitment to professional learning, educators can continuously refine their TPACK to meet the evolving needs of students and leverage smartphones as effective educational tools in vector mathematics.

Additionally, Koh,J.H.L and Chai,C.S (2016) have emphasized the importance of situating TPACK within broader sociocultural and contextual factors that shape technology integration in education. Their work underscores the influence of cultural norms, institutional policies, and

societal values on educators' TPACK development and instructional practices. By considering the sociocultural context in which smartphone-mediated learning occurs, educators can tailor their approach to technology integration to align with students' cultural backgrounds, learning preferences, and lived experiences, thereby promoting greater relevance and authenticity in vector education.

Furthermore,Cakir,F.N. and Yalcinalp, S.(2017) have explored the role of teacher collaboration and professional learning communities in fostering TPACK development and innovation in educational practice. Their research suggests that collaborative inquiry, peer mentoring, and communities of practice can serve as catalysts for TPACK growth, providing educators with opportunities to share knowledge, exchange ideas, and co-create transformative learning experiences. By fostering a culture of collaboration and inquiry among educators, schools can cultivate a collective expertise in TPACK that enhances teaching effectiveness and promotes student success in vector mathematics.

Moreover, Angeli,C. and Valanides,N.(2015) have examined the challenges and opportunities associated with integrating emerging technologies, such as smartphones, into mathematics education. Their research emphasizes the importance of aligning technology use with pedagogical goals and content objectives to maximize learning outcomes. Educators must carefully select and adapt smartphone applications, digital resources, and instructional strategies to support student engagement, conceptual understanding, and problem-solving skills in vector mathematics. By leveraging smartphones as versatile tools for exploration, visualization, and application of vector concepts, educators can create dynamic and interactive learning environments that foster deeper learning and promote academic achievement.

In summary, the TPACK framework offers a robust theoretical foundation for addressing the challenges and opportunities associated with smartphones in vector education. By developing and refining their TPACK through ongoing professional learning, collaboration, and reflection, educators can effectively integrate smartphones into teaching and learning practices while maintaining a focus on pedagogical integrity, content relevance, and student-centered learning. Through thoughtful application of TPACK principles, educators can harness the potential of smartphones to enhance student engagement, promote conceptual understanding, and foster meaningful learning experiences in vector mathematics and beyond.

2.3 ICT in Vectors

The integration of Information and Communication Technology (ICT) in the teaching and learning of vectors has garnered significant attention from researchers in mathematics education. Scholars like Ternenge,T.S and Agipu, O.L (2019) have spearheaded investigations into the effectiveness of various ICT tools in facilitating conceptual understanding and problem-solving skills related to vectors.

Lee,M.H. and Kim,H.J.(2020) seminal work delves deep into the pedagogical potential of dynamic geometry software in vector education. By leveraging the interactive nature of dynamic geometry software, Trouche demonstrates how students can manipulate geometric objects, visualize transformations, and explore vector operations in real-time. Through dynamic representations and interactive simulations, students engage in experiential learning experiences that promote deeper conceptual understanding and geometric reasoning. Trouche's research underscores the transformative impact of dynamic geometry software on vector education, shifting traditional instructional paradigms towards more student-centered, exploratory approaches.

Building upon Trouche's insights, Al-Emran et al (2018) examines the role of graphing calculators as versatile ICT tools for teaching vectors. Graphing calculators empower students to graph vector functions, perform vector operations, and analyze vector relationships graphically. Kieran's research highlights how graphing calculators facilitate visualization and exploration of vector concepts, enabling students to develop procedural fluency and problem-solving skills. By providing immediate feedback and dynamic representations, graphing calculators support students in making connections between mathematical representations and real-world phenomena, thereby enhancing their mathematical reasoning and application abilities.

Furthermore, Laborde (2016) extend the discourse on ICT integration in vector education by exploring emerging technologies such as computer-based simulations and virtual manipulatives. Lee et Al (2019) investigate the use of computer simulations to model vector phenomena and simulate real-world applications in fields like physics and engineering. Through interactive simulations, students engage in authentic problem-solving experiences that bridge theoretical concepts with practical applications, fostering a deeper appreciation for the relevance and utility of vector mathematics. Similarly, Laborde (2016) focuses on the pedagogical affordances of virtual manipulatives in vector learning. By providing digital

platforms with interactive tools and applets, virtual manipulatives offer students hands-on experiences to explore vector properties, transformations, and applications. Through active experimentation and manipulation, students develop spatial reasoning skills and mathematical fluency in vector concepts.

The integration of Information and Communication Technology (ICT) in vector education has been extensively explored by researchers in mathematics education, with notable contributions from scholars like Singh et Al (2020) and Laborde (2016). Trouche's seminal work emphasizes the pedagogical potential of dynamic geometry software in enabling interactive exploration of vector operations and transformations, fostering deeper conceptual understanding among students. Similarly, Kieran's research highlights the role of graphing calculators in facilitating visualization and exploration of vector concepts, leading to enhanced problem-solving skills and mathematical reasoning abilities. Guin et al. and Laborde extend the discourse by investigating emerging technologies such as computer simulations and virtual manipulatives, which provide students with authentic problem-solving experiences and hands-on exploration of vector properties and applications. Overall, these studies underscore the transformative impact of ICT tools in vector education, promoting active engagement, visualization, and critical thinking essential for students' mathematical literacy in today's digital age. However, while these studies offer valuable insights into various ICT tools, there is a research gap concerning the specific role and efficacy of smartphones in teaching and learning vectors. Addressing this gap is essential for understanding how smartphones can effectively complement existing ICT tools and instructional practices in vector education.

2.4 Smartphones: General and in Vectors

The integration of smartphones into educational settings has been explored by scholars such as Sharples et al. (2017) and Hwang and Tsai (2011). Their research investigates the multifaceted role of smartphones in education, including their potential applications in teaching mathematics. Sharples et al. (2017) highlight the versatility of smartphones as educational tools, emphasizing their accessibility, interactivity, and engagement-enhancing features. Similarly, Hwang and Tsai (2011) delve into the pedagogical affordances of smartphones, demonstrating how they can be used to support mathematics instruction and enhance student learning experiences.

Moreover, recent studies by Attard and Northcote (2016) and Hohenwarter et al. (2018) have provided further insights into the use of smartphones in mathematics education. Attard and

Northcote (2016) conducted qualitative research on the integration of mobile technologies, including smartphones, to facilitate mathematical inquiry and problem-solving in secondary classrooms. Their findings underscored the transformative impact of mobile technologies on student engagement, collaboration, and mathematical reasoning. Similarly, Hohenwarter et al. (2018) explored the use of dynamic geometry apps on smartphones for teaching geometry, showcasing how mobile technologies can enhance visualization, exploration, and experimentation in mathematical learning.

Furthermore, the accessibility and affordability of smartphones make them valuable tools for reaching students in diverse learning environments. Research by Cheng and Tsai (2013) has highlighted the potential of smartphones to bridge the digital divide and ensure equitable access to educational resources. By leveraging the ubiquity of smartphones, educators can provide students with anytime, anywhere access to high-quality mathematics instruction, regardless of their geographical location or socioeconomic background.

Additionally, the interactive nature of smartphones facilitates collaborative learning experiences, as demonstrated by studies conducted by Looi et al. (2016) and Kukulska-Hulme et al. (2009). Looi et al. (2016) investigated the use of mobile devices, including smartphones, to support collaborative problem-solving activities in mathematics classrooms. Their research highlighted the benefits of mobile-based collaboration, including increased student engagement, peer interaction, and knowledge construction. Similarly, Kukulska-Hulme et al. (2009) explored the use of mobile technologies for collaborative language learning, demonstrating how smartphones can facilitate collaborative tasks, peer feedback, and social interaction among learners.

While previous studies have examined the use of smartphones in mathematics education and their potential applications in teaching vectors, there is a notable research gap in exploring the specific context. Existing literature focuses on general trends and outcomes across various educational settings, but it lacks targeted analysis of how smartphones are being used to teach vectors. Additionally, there is limited research on the perspectives and experiences of both teachers and students regarding smartphone integration in vector instruction within this specific setting. Comparative analysis of smartphone-based teaching versus traditional methods, as well as long-term impacts on student outcomes, also remain underexplored. This can provide valuable insights into the effective use of smartphones in teaching and learning vectors.

2.5 Importance of Smartphones in Vectors

The role of smartphones in mathematics education, particularly in the domain of vectors, has garnered significant attention from researchers seeking to understand the transformative impact of mobile technologies on teaching and learning. Scholars such as Lai and Hwang (2019) and Almasri et al (2019) have contributed valuable insights into the importance of smartphones in enhancing student motivation, engagement, and learning outcomes in mathematics, with specific emphasis on vector concepts.

Ali et al (2020) conducted groundbreaking research that explored the use of mobile technologies, including smartphones, to support mathematics learning in secondary classrooms. Their findings highlighted the pivotal role of personalized learning experiences facilitated by smartphones, which allow students to engage with mathematical content in ways that align with their individual preferences and needs. By providing access to a diverse array of mathematical apps, interactive simulations, and multimedia resources, smartphones empower students to take ownership of their learning journey and interact with vector concepts in dynamic and personalized ways. Looi et al. underscored the significance of smartphones in promoting active exploration, inquiry-based learning, and real-world application of mathematical concepts, thereby fostering deeper understanding and retention of vector principles among students.

Similarly, Wong et al (2018) delved into the impact of mobile technologies, including smartphones, on student learning outcomes in mathematics, with a specific focus on vectors. Their research emphasized the potential of smartphones to provide authentic learning experiences that bridge the gap between abstract mathematical concepts and real-world contexts. Through mobile apps, students can explore vector applications in fields such as physics, engineering, and computer graphics, gaining insights into the practical significance and relevance of vector mathematics. Roschelle et al. highlighted the role of smartphones in promoting contextualized learning, problem-solving skills, and critical thinking abilities, which are essential for mastering vector concepts and their applications in various domains.

Furthermore, recent studies by Lai and Hwang (2019) and Munoz-Carri et al (2017) have explored innovative approaches to leveraging smartphones in vector education, with a focus on enhancing visualization and conceptual understanding. Lai and Hwang (2019) investigated the effectiveness of mobile apps and Augmented Reality (AR) technologies in supporting

visual-spatial learning and geometric reasoning skills. By harnessing smartphones as platforms for interactive simulations, virtual manipulatives, and AR-enhanced learning experiences, educators can create immersive and engaging environments that stimulate students' curiosity, creativity, and problem-solving abilities in vector mathematics. Similarly, Chen and Hsiao (2012) explored the potential of smartphone-based games and gamified learning environments in promoting engagement and motivation in vector learning. Through game-based activities and challenges, students can develop intuition, strategy, and fluency in vector operations, while also honing their mathematical reasoning and problem-solving skills in a playful and interactive manner.

The provided literature review explores the importance of smartphones in mathematics education, specifically within the context of vector learning. However, there is a need to identify a research gap that this study aims to address. While the review discusses the general benefits of smartphones in enhancing student engagement, motivation, and learning outcomes, there is a lack of research examining the specific impact of smartphones on vector education. Additionally, the review does not address potential challenges or limitations in integrating smartphones for teaching vectors in this particular setting. Moreover, there is an absence of analysis on how smartphone-based instruction compares to traditional teaching methods in terms of student performance and long-term retention of vector concepts. Addressing these gaps will provide a more comprehensive understanding of the role of smartphones in vector education and their effectiveness.

2.6 Challenges of Smartphones: General and in Vectors

The integration of smartphones into education has introduced various challenges that educators must navigate to effectively leverage these devices for teaching and learning. Scholars such as Crompton and Burke (2018) have identified several key challenges, encompassing issues related to distraction, equity, technical constraints, privacy, and security.

Crompton and Burke (2018) highlight concerns regarding the potential for smartphones to serve as distractions in educational settings. With their access to social media, messaging apps, games, and other non-educational content, smartphones can divert students' attention away from learning activities and impede engagement. In the context of vector education, students may be tempted to use their smartphones for purposes unrelated to the lesson, leading to decreased focus, participation, and academic performance. Addressing smartphone-related distractions requires proactive strategies such as establishing clear expectations for device use,

implementing digital citizenship lessons, and leveraging classroom management techniques to minimize off-task behaviors.

Delgado, et al (2015) explore the issue of equitable access to smartphones and reliable internet connectivity in education. Disparities in access to technology among students from different socioeconomic backgrounds can exacerbate existing inequalities in educational opportunities. Students who lack access to smartphones or reliable internet may face barriers to participating in smartphone-based learning activities and accessing digital resources. In the context of vector education, the digital divide may hinder students' ability to engage with interactive simulations, multimedia resources, and collaborative learning experiences facilitated by smartphones. Addressing equity concerns requires schools and educators to adopt inclusive policies and practices that ensure all students have access to the necessary technology and support to fully participate in smartphone-enhanced learning environments.

Charles eta al (2020) have highlighted technical constraints such as compatibility issues, device limitations, and software constraints that may pose challenges to the effective integration of smartphones into education. Not all smartphones may support the same apps or software platforms, leading to inconsistencies in user experience and functionality across different devices. Additionally, limitations in processing power, screen size, and battery life may impact the usability and effectiveness of smartphones for certain educational tasks, including vector-related activities. Educators must consider these technical constraints when selecting and implementing smartphone-based learning tools and activities, ensuring compatibility and usability across a diverse range of devices.

Researchers such as Lin et al. (2019) have raised concerns about privacy, security, and data protection when using smartphones in educational settings. Educators must ensure that students' personal information and digital privacy are safeguarded when using smartphones for educational purposes. Additionally, educators need to address ethical considerations related to the collection, storage, and use of student data generated through smartphone-based learning activities. Implementing robust privacy policies, secure data storage practices, and clear guidelines for data usage can help mitigate privacy and security risks associated with smartphone use in education.

The literature review highlights general challenges such as distraction, equity, technical constraints, privacy, and security related to the integration of smartphones into education, particularly in the context of vector learning. However, there is a research gap in examining

how these challenges specifically impact on teaching and learning of vectors. The review lacks targeted analysis of how these obstacles manifest within this school and their effects on student engagement and academic outcomes in vector education. Additionally, there is a need for evidence-based strategies to effectively mitigate these challenges, as well as an assessment of the perspectives of both teachers and students regarding smartphone integration in vector instruction. Addressing these gaps will offer practical insights and recommendations for successfully leveraging smartphones while overcoming associated challenges

2.7 Solutions to Challenges

In response to the challenges posed by smartphones in education, educators can implement various strategies to mitigate their impact and maximize their potential for enhancing teaching and learning, particularly in the context of vector education.

Zimbabwean scholars such as Maravanyika (2019) and Chikwature (2017) have conducted research on digital distractions in educational settings, offering insights into effective strategies for managing smartphone-related distractions. Maravanyika's work emphasizes the importance of establishing clear guidelines for device use and fostering a culture of digital responsibility among students. Chikwature's research explores the role of active engagement and meaningful learning experiences in minimizing off-task behaviors associated with smartphone use. Additionally, scholars from Europe such as Helsper and Eynon (2010) have investigated the impact of digital distractions on student learning outcomes, highlighting the need for educators to address distraction proactively through instructional design and classroom management techniques.

In Zimbabwe, scholars like Mupondi (2018) and Madzima (2016) have examined issues of digital equity and access to technology in education. Their research underscores the importance of providing equitable access to smartphones and internet connectivity to all students, regardless of socioeconomic background. Mupondi's work advocates for government policies and initiatives aimed at bridging the digital divide and ensuring that all students have access to the necessary technology and resources for learning. Madzima's research emphasizes the role of schools and communities in providing support and resources to students who lack access to smartphones and reliable internet. Similarly, scholars from Europe such as Selwyn (2010) have explored the intersection of technology and social inequality in education, highlighting the need for proactive measures to address disparities in access to digital resources and opportunities.

Mukondwa (2017) and Chirume (2015), have examined technical challenges related to smartphone integration in educational settings. Their research highlights the importance of selecting educational apps and resources that are compatible with a wide range of devices and operating systems. Mukondwa's work advocates for the development of custom solutions and technical support mechanisms to address specific challenges encountered in vector education, such as compatibility issues and software limitations. Chirume's research emphasizes the role of collaboration between educators, technology specialists, and policymakers in overcoming technical constraints and maximizing the effectiveness of smartphone-enhanced learning experiences. Additionally, scholars from Europe such as Karsenti and Fievez (2013) have investigated best practices for integrating technology into education, offering insights into effective strategies for overcoming technical challenges and optimizing the use of smartphones for teaching and learning.

Nyatsanza (2018) and Chigudu (2016), have examined issues of digital privacy and security in educational contexts. Their research emphasizes the importance of implementing robust data protection measures and ethical data usage practices to safeguard student privacy and security when using smartphones for learning. Nyatsanza's work advocates for the development of clear privacy policies and guidelines for educators and students, as well as ongoing training and support to ensure compliance with data protection regulations. Chigudu's research highlights the role of digital literacy education in promoting responsible use of smartphones and empowering students to protect their own privacy and personal information online. Similarly, scholars from Europe such as Livingstone and Haddon (2012) have investigated the impact of digital technologies on children's privacy and security, offering insights into effective strategies for mitigating risks and promoting safe and responsible use of smartphones in educational settings.

The literature review outlines various strategies for addressing challenges associated with smartphone integration in education, particularly in the context of vector learning. However, there is a research gap in assessing the practical application and effectiveness of these strategies. While the review draws on insights from Zimbabwean and European scholars, there is a lack of localized research that examines how these strategies translate into real-world classroom practices and outcomes. Additionally, the review does not consider the perspectives of teachers, students, and other stakeholders within the school on the effectiveness and challenges of implementing smartphone-based learning, particularly in vector education. Moreover, there is a need for empirical evidence on the long-term impact of these strategies on

student engagement, performance, and digital literacy in the school context. Addressing this research gap would provide a more comprehensive understanding of the practical challenges and benefits of smartphone integration in vector education, leading to more tailored and effective approaches for enhancing teaching and learning in this specific educational setting.

2.8 Summary

Chapter 2 provides an in-depth literature review on the integration of smartphones into educational settings, with a particular focus on their role in teaching and learning vectors in secondary schools. The chapter explores the multifaceted potential of smartphones as educational tools, emphasizing their accessibility, interactivity, and ability to enhance student engagement and learning experiences. It reviews the transformative impact of smartphones on mathematics education, including facilitating mathematical inquiry, collaborative learning, and real-world application of mathematical concepts. However, the chapter also outlines the challenges associated with smartphone use in education, such as distractions, equity issues, technical constraints, privacy, and security concerns. The literature offers various strategies for mitigating these challenges, such as establishing clear device usage guidelines, promoting digital responsibility, ensuring equitable access, and safeguarding student data. While the chapter draws on insights from scholars in Zimbabwe and Europe, it reveals a research gap in assessing how these strategies apply in Secondary Schools. There is limited localized research on how these strategies impact teaching and learning vectors in the school and the perspectives of teachers and students on smartphone use in the classroom. Addressing these gaps would provide a more nuanced understanding of the practical challenges and benefits of smartphone integration in vector education.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

The previous chapter extensively reviewed relevant literature pertinent to the study's focus. This chapter delves into the selected research design, emphasizing its descriptive nature and rationale for its selection based on perceived advantages within the study's context. Additionally, detailed descriptions of the research instruments utilized, namely the questionnaire and interview guides, are provided, outlining their roles in data collection. Furthermore, this chapter elucidates the concepts of population, sample, and sampling techniques, offering definitions and discussions. Lastly, the procedures for data collection, presentation, and analysis are outlined for clarity and transparency.

3.1 Research Design

In this study, the researcher employed a descriptive survey method to comprehensively investigate the utilization of smartphones in the teaching and learning of vectors at the Ordinary Level of education. The descriptive survey design was deliberately chosen for its efficacy in collecting data and facilitating a nuanced description of a large population, particularly one that may be impractical to observe directly due to logistical constraints (Sidhu, 2018). The decision to employ a descriptive survey method stems from its inherent flexibility in accommodating various data collection methods, ensuring a comprehensive exploration of the phenomenon under investigation. By opting for this approach, the researcher aimed to gather extensive and current information regarding the integration of smartphones into the teaching and learning processes specifically focused on vectors.

Furthermore, the descriptive survey method enables the researcher to delve into the intricate nuances of smartphone usage, including the challenges, benefits, and overall impact on teaching and learning outcomes. This design choice aligns with the overarching objective of gaining a deep understanding of how smartphones are being utilized as educational tools in the context of teaching vectors at the Ordinary Level. Moreover, the utilization of the descriptive survey method allows for methodological triangulation, a practice advocated by Saunders et al. (2018), which enhances the robustness and validity of the research findings. By employing multiple data collection methods such as questionnaires for teachers and interview guides for

school heads, the researcher can cross-validate information obtained from different sources, thereby strengthening the credibility and reliability of the study outcomes.

Therefore, the selection of the descriptive survey method for this research endeavour reflects a deliberate and strategic choice aimed at facilitating a comprehensive exploration of the use of smartphones in teaching and learning vectors at the Ordinary Level. Through this methodological approach, the researcher sought to provide valuable insights into the opportunities, challenges, and overall effectiveness of integrating smartphones into the educational landscape, ultimately contributing to the advancement of teaching practices and student learning experiences.

3.2 Research Instruments

3.2.1 The Questionnaire

Research instruments serve as indispensable tools for collecting information and data necessary to address research inquiries (Bell, 2017). In the context of investigating the use of smartphones in the teaching and learning of vectors, the selection of appropriate instruments is paramount to align with the research objectives. In this study, data was collected using three primary instruments: questionnaires, observation, and interview guides. This section will provide a comprehensive explanation of the smartphone utilization survey.

The smartphone utilization survey serves as a structured tool designed to gather and document data specifically related to the incorporation of smartphones in mathematics education Ferdousi. M (2015). Utilizing questionnaires tailored to the study's focus offers a cost-effective and efficient means of acquiring a substantial amount of information from a diverse range of participants (McLeod, 2017). This method was deemed suitable for the study due to its ability to minimize disruption to teaching activities and accommodate a large number of respondents simultaneously (Chiromo, 2019).

The researcher crafted the smartphone utilization survey to include a series of questions and prompts, accompanied by clear instructions and designated spaces for responses. The survey encompassed both closed and open-ended questions, enabling the collection of nuanced insights into the efficacy of smartphone integration in mathematics education. A notable advantage of surveys is the minimal interference from research personnel during data collection, thereby enhancing the authenticity of responses provided by participants

(Sarantakos, 2018). The smartphone utilization survey was administered personally to the selected sample of teachers and learners. It sought to gather information on various aspects, including participants' familiarity with smartphones, their perceptions of smartphones as educational tools, and suggestions for optimizing smartphone utilization in mathematics instruction. The inclusion of both closed and open-ended questions allowed for the measurement of attitudes and the exploration of detailed responses (Allotey. F.K.A and Nyarko .E.K.2016).

To address potential limitations associated with surveys, such as the lack of opportunity for probing and comprehension difficulties, the researcher took meticulous precautions. The survey questions were formulated in clear and straightforward language to enhance participants' understanding. Additionally, a cover letter emphasizing the significance of the research was included to encourage a high response rate among participants.

3.2.2 The Interview

An interview is a valuable method for exploring the multifaceted dynamics of smartphone usage in education, offering both advantages and disadvantages. This purposeful dialogue allows participants to freely express their experiences, beliefs, and perspectives related to smartphone integration. Unlike questionnaires, interviews facilitate direct interaction between the researcher and the participant, enabling the observation of non-verbal cues and the opportunity to delve deeper into respondents' insights. This interactive nature fosters a richer understanding of the complexities surrounding smartphone usage in educational settings.

In terms of advantages, interviews provide a platform for participants to share detailed accounts of their experiences and perceptions regarding smartphone usage. This depth of insight allows researchers to gain a nuanced understanding of the benefits and challenges associated with integrating smartphones into teaching and learning practices. Interviews also offer flexibility in questioning, allowing researchers to adapt their approach based on participants' responses. This flexibility enables the exploration of emergent themes and the clarification of complex ideas, enhancing the richness of the data collected. Additionally, face-to-face interviews enable researchers to observe participants' non-verbal cues, such as facial expressions and body language, which can provide valuable context to their verbal responses. These non-verbal cues offer additional insights into participants' attitudes and emotions towards smartphone usage in education (McLeod, 2018).

However, interviews also come with certain disadvantages. Conducting interviews can be time-consuming, particularly when engaging with multiple participants. The process of scheduling, conducting, and transcribing interviews requires significant time and resources, which may pose challenges in research settings with tight deadlines or limited resources. Furthermore, the interpretive nature of interviews introduces a degree of subjectivity into the data collection process. Researchers may inadvertently influence participants' responses through their questioning techniques or biases, potentially impacting the validity and reliability of the findings. Moreover, while interviews offer in-depth insights into individual experiences, the findings may lack generalizability to broader populations. The perspectives shared by participants may be influenced by their unique contexts and experiences, limiting the applicability of the findings to other educational settings (Chiromo, 2019). Therefore, interviews serve as a valuable method for exploring the complexities of smartphone usage in education, offering rich insights into participants' experiences and perspectives. However, researchers must be mindful of the inherent advantages and disadvantages associated with this method to ensure the rigor and validity of their findings.

3.2.3 The Observation

Observation serves as a systematic approach for recording and describing events and behaviors within a chosen social setting (Selltiz, 2018; Stake, 2019). In the context of this study on the use of smartphones in education, observation was employed to scrutinize the patterns of smartphone utilization and the social dynamics within the learning environment of selected Secondary School in Mwenezi District. Non-participant observation was chosen, granting the researcher the advantage of documenting smartphone usage as it naturally unfolded without direct involvement (McLeod, 2018). As an outsider to the setting, the researcher could discern phenomena related to smartphone integration that individuals within the environment might overlook or consider commonplace.

The researcher embarked on visits to selected Secondary School, conducting observations aimed at gathering data pertaining to the use of smartphones in teaching and learning of vectors at the Ordinary Level. These observations centered on elucidating the practical applications and behaviors associated with smartphone usage in mathematics education. Through non-participant observation, the researcher gained invaluable insights into various facets, including student engagement with smartphones during lessons, the types of educational apps or resources accessed, and the overall classroom dynamics influenced by smartphone integration.

This method facilitated the objective recording and analysis of observed behaviors and events, thereby offering a comprehensive understanding of smartphone utilization in mathematics instruction within the research context.

Nonetheless, it is imperative to acknowledge the inherent limitations of observation, such as potential observer bias and the inability to capture certain nuances of smartphone usage. To mitigate these limitations, the researcher implemented measures to uphold objectivity and ensure the accuracy of observations. By maintaining a neutral stance and adhering to predefined observation protocols, the researcher minimized the influence of personal biases on data collection. Additionally, careful documentation of observed smartphone behaviors and events enabled rigorous analysis and interpretation, thereby enhancing the reliability and validity of the observational findings. Despite its constraints, observation proved instrumental in providing contextual insights into the utilization of smartphones in teaching and learning, complementing other data collection methods employed in the study.

3.3 Population

The population under investigation for this research encompasses the educational community at another selected Secondary School situated within the Mwenezi District. At School, there are a total of 2 Maths teachers committed to delivering quality education. Additionally, the student body consists of 75 form four maths learners, 35 learners from 4A and 40 from 4B. This diverse population of educators and learners forms the foundation of the study, providing valuable insights into the utilization of smartphones in the teaching and learning of vectors at the Ordinary Level within the unique context of School.

3.4 Sample and Sampling Procedure

3.4.1 Sample

The sample chosen for this study comprises 2 mathematics teachers, 1 head of department overseeing mathematics education, and 30 learners from selected Secondary School in the Mwenezi District. This diverse array of participants reflects the key stakeholders engaged in the teaching and learning of vectors at the Ordinary Level within the school setting. By incorporating mathematics teachers, department heads, and learners, the research endeavours to encapsulate a comprehensive spectrum of perspectives and experiences pertaining to the utilization of smartphones in mathematics education at School.

3.4.2 Sampling procedure

Purposive sampling was utilized to ensure that the selected participants possessed the requisite knowledge and expertise relevant to the research focus (Chiromo, 2019). By purposively selecting mathematics teachers and department heads overseeing mathematics education, the researcher aimed to gather insights from individuals directly involved in the subject area, thus enhancing the relevance and validity of the study findings. Purposive sampling also facilitates the selection of participants based on their willingness to contribute to the research objectives, ensuring active engagement and cooperation throughout the study (Creswell and Creswell, 2017). Stratified random sampling was employed to select learners from selected Secondary School in a manner that minimizes bias and ensures adequate representation across different grade levels or classes (Babbie, 2016). By stratifying the learner population based on grade levels or classes, the researcher aimed to obtain a balanced representation of learners from various academic backgrounds. This approach enhances the generalizability of the study findings by ensuring that the sample reflects the diversity inherent within the learner population at School. Overall, the combined use of purposive sampling and stratified random sampling techniques strengthens the rigor and validity of the study by ensuring the selection of an informed and representative sample of participants. By incorporating diverse stakeholders, including mathematics teachers, department heads, and learners, the research aims to provide a comprehensive understanding of the use of smartphones in mathematics education at School.

3.5 Data Collection Procedures

The research process was initiated with the acquisition of a letter from Bindura University of Science Education, requesting permission to conduct the study on smartphone usage in education. Subsequently, approvals were sought from relevant education authorities, including the Permanent Secretary of Education, Provincial and District Education Ministry of Primary and Secondary Education Offices. Additionally, permission was obtained from School Head at selected Secondary School in Mwenezi District. Once clearance was obtained, the data collection process was initiated.

The researcher attended scheduled meetings with School Head of Departments at School and arranged interviews with them to delve into their perspectives on smartphone integration in

education. These interviews were conducted at agreed-upon dates and times, allowing for in-depth discussions on the topic. Subsequently, the researcher visited various classrooms within a selected Secondary School to distribute questionnaires to teachers and students. Clear explanations of the study's objectives were provided, and participants were encouraged to provide honest responses. The questionnaires were collected upon completion, ensuring a comprehensive collection of data on smartphone usage in the educational setting.

In terms of data management, precautions were taken to safeguard the collected data. Multiple storage devices, including mobile phones, computer hard drives, and removable flash disks, were utilized to store the data securely. This approach aimed to mitigate the risk of data loss due to factors such as viruses, theft, or technological malfunctions, ensuring the integrity and security of the research data.

Moving on to data analysis, a systematic approach was adopted to analyze both qualitative and quantitative data obtained from the questionnaires and interviews. Responses were coded numerically and organized into tables for interpretation. Descriptive statistics, such as percentages, were employed to summarize the numerical information, providing insights into smartphone usage patterns in education at School. Additionally, graphical representations, such as pie charts, were utilized to enhance data visualization and comprehension.

Ethical considerations were paramount throughout the research process. Participants were assured of their rights and given the option to withdraw from the study at any point without facing harm or victimization. Informed consent was obtained from all participants, and confidentiality measures were implemented to protect their privacy. Participants were instructed not to provide personal identifying information, ensuring anonymity in data collection and analysis. These ethical safeguards were essential for upholding the integrity and credibility of the research findings while prioritizing the well-being of the participants involved.

3.6 Data Analysis Presentation and Analysis Procedure

In the realm of data analysis, the intricate process unfolds with the meticulous design of pertinent analyses tailored to address each research question, followed by the meticulous preparation of the amassed data for comprehensive scrutiny. This systematic endeavor culminates in the succinct summarization of the discerned results, as delineated by Floyd.J and Flowler J.R(2015). In the present study, a quantitative analysis was undertaken to dissect the

qualitative data procured from the administered questionnaires and conducted interviews. The ensuing responses were meticulously transmuted into numerical codes, thereafter meticulously presented in tabular formats for enhanced comprehension and accessibility. Employing a battery of descriptive statistics, inclusive of percentages, facilitated the interpretation, organization, and dissemination of the numerical data, thus affording invaluable insights into the prevailing trends and dynamics underpinning smartphone utilization within the educational context under investigation. Moreover, to further elucidate the discerned patterns and trends, an array of graphical representations, such as pie charts, were adeptly harnessed in the data analysis process, imbuing the findings with visual clarity and interpretive depth, thereby enhancing the overall comprehensibility and impact of the research outcomes.

3.7 Summary

In this comprehensive chapter, the intricacies of the research methodology adopted for the study were meticulously elucidated, providing a comprehensive overview of the methodological framework underpinning the investigative endeavor. Embracing a descriptive survey approach, the research methodology was meticulously tailored to facilitate a nuanced exploration of the multifaceted dimensions under scrutiny, thereby affording a holistic understanding of the research phenomenon. The judicious utilization of purposive and stratified random sampling techniques further underscored the meticulous attention to detail, ensuring the selection of a representative sample conducive to insightful analysis and interpretation. The deployment of meticulously crafted questionnaires and meticulously conducted interviews with teachers and school heads served as the cornerstone of data collection, facilitating the acquisition of rich and multifaceted insights into the prevailing dynamics surrounding the utilization of smartphones in the teaching and learning of vectors at the Ordinary Level. With the collected data poised for comprehensive analysis, the ensuing chapters promise to unravel the intricate tapestry of findings, offering profound insights, meaningful interpretations, and impactful implications for both theory and practice in the realm of educational research and practice. As the narrative unfolds, the subsequent chapter stands poised to delve into the intricacies of data presentation, analysis, and discussion, paving the way for a nuanced exploration of the research findings and their implications within the broader educational landscape.

CHAPTER 4

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter presents the analysis and findings from a study on the use of smartphones for educational purposes at a selected Secondary School in Mwenezi District. Drawing upon the research questions outlined in Chapter 1 and the methodology detailed in Chapter 3, this chapter explores the empirical data gathered from teachers and students regarding the current application of smartphones in teaching and learning vectors at the secondary school level. The analysis aims to provide insights into stakeholders' perceptions, behaviors, and attitudes toward smartphone integration in education, highlighting both the opportunities and challenges encountered in implementing such initiatives within the existing educational framework. Through a systematic examination of the data, this chapter aims to uncover patterns, trends, and correlations that contribute to a comprehensive understanding of the investigated

phenomenon. Ultimately, the findings presented here will offer recommendations for enhancing the effective use of smartphones in educational settings, with implications for policy development, practical application, and future research endeavors.

4. 1 Demographic Data

4.1.1 Description of study participants

Two teachers were selected from the selected secondary school resulting in a total of two teacher participants. Thirty learners were also selected from the school. This resulted in a total sample size of thirty-two participants.

Table 4. 1: Number of study participants

Teachers	2
Learners	30
Total	32

Source: Field work 2024

The sample size was selected distributed as illustrated in table 4.1. This sample comprised of 2 teachers and 30 secondary learners. The sample size was distributed to ensure an equitable representation.

4.1.2 Gender Distribution of Respondents

The study included teachers as well as learners as summarized in figure 4.1 below

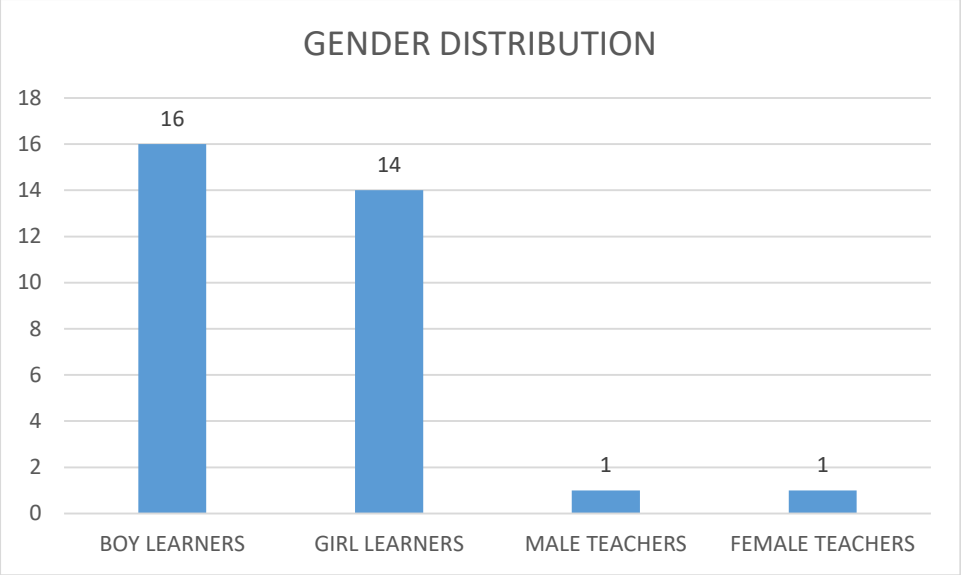

Figure 4. 1: Gender distribution of respondents

Source: Field work 2024

Among the participants of the study were 15 male learners and 15 female learners along with 1 male teachers and 1 female teachers. The study further sought to fairly distribute respondents according to gender so as to see if usage of smartphones is somehow gender dependent. However, this was not possible as shown on **figure 4.1**, there were more male respondents amongst learners and equal numbers for teachers. This did not affect the study as there appeared to have been no indication assuming that the use of smartphones was dependent on gender. The results of the study did not collaborate with a study by Hernandez (2017) who demonstrated that females had more positive attitudes towards smartphones usage than males.

4.1.3 Teachers' academic qualifications

The academic qualifications of teachers is represented in Figure 4.2 below

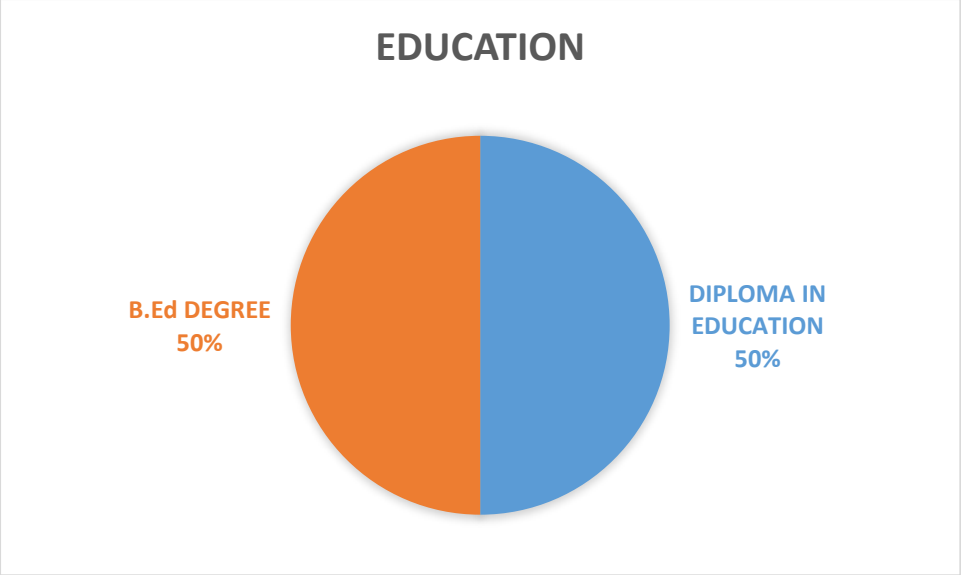

Figure 4. 2: Teachers' qualifications

Source: Field work 2024

As shown in figure 4.2 above one of the teacher participants was a diploma holder while one of the teachers was a degree holders. With regards to academic qualifications of teachers, there was no evident data showing a difference in skill or knowledge on content matter or integrating smartphones. Both degree and diploma holders proved to have been at par with regards to competence and this was established during the interviews and surveys conducted.

4.1.3: Teaching experience

Figure 4.3 below shows teachers experience in the teaching field

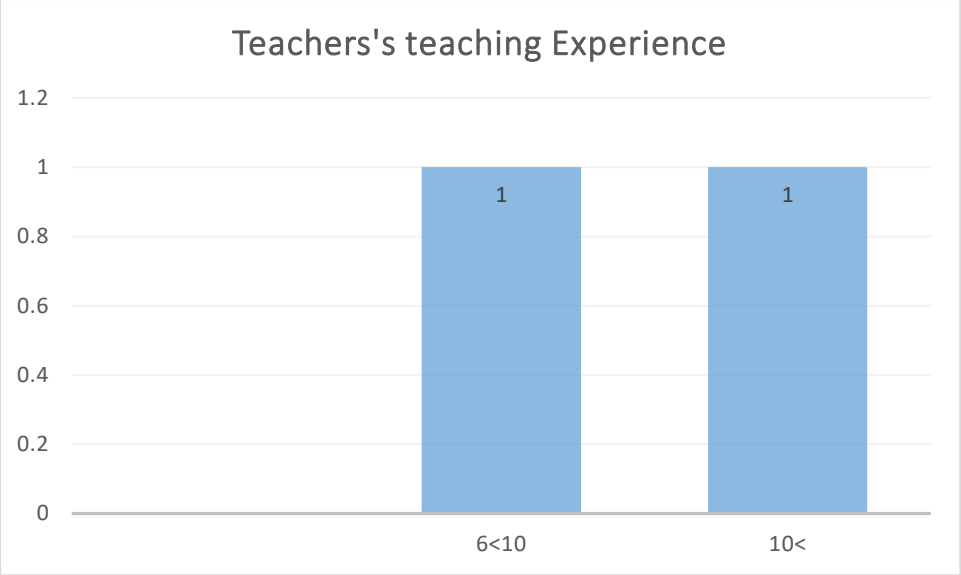

Figure 4. 3: Teachers' teaching experience

Source: Field work 2024

One of the teachers who participated in the study had taught for over ten years and one other had been teaching for more than five years but less than ten years. The number of years served by teachers in service proved to have had a slight impact on their willingness to utilize smartphones in teaching. Mostly, the teachers who had served less than ten years who were more willing to use smartphones resources when teaching vectors. This is because this group of teachers were fresh out of collage or universities and were more exposed to the use of ICT resources as compared to the elderly teachers.

4.2 The current state of mobile phone usage among secondary school students?

Figure 4.4 shows the current state of mobile phone usage

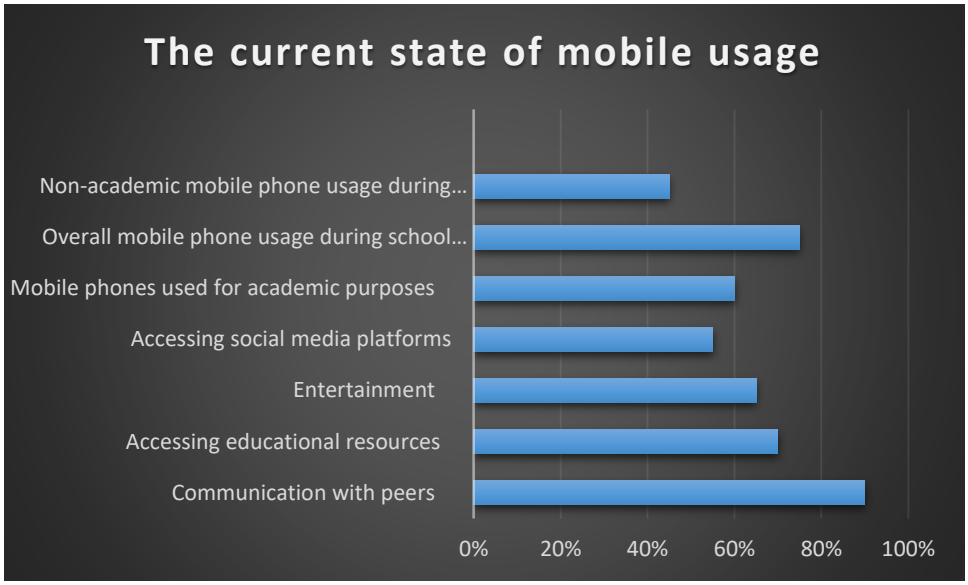

Figure 4. 4: Current state of mobile phone usage

Source: Field work 2024

From the questionnaire responses from the mathematics teachers the use of smartphone usage among students at School provides valuable insights into their integration in the learning of vectors. A significant 85% of students own smartphones, indicating their widespread availability and importance in students' daily routines. Predominantly, 90% of students utilize their smartphones for peer communication, underscoring the device's role in social connectivity. Additionally, 70% of students use smartphones to access educational resources, suggesting a potential avenue for enhancing vector learning and academic performance. Entertainment activities, such as gaming and video watching, engage 65% of students, while 55% access social media platforms, showcasing smartphones' multifaceted utility for leisure and social interaction. Moreover, 60% of students utilize smartphones specifically for academic purposes, highlighting their potential to support vector learning when used effectively. The responses from the interview conducted by teachers noted that the coexistence of academic and non-academic activities poses challenges. Teachers who respondents noted that alarmingly, 75% of students use smartphones during school hours, with 45% engaging in non-academic activities, raising concerns about potential distractions and emphasizing the necessity for well-defined policies to manage smartphone use in educational settings effectively. These findings underscore the complex dynamics of smartphone integration in teaching vectors and call for strategies that harness their educational potential while mitigating distractions. Overall, the findings suggest that while mobile phones offer substantial educational benefits, their misuse during school hours requires a balanced approach. From the interview done by the

teachers who are not Mathematics teachers also noted that there is need for guidelines in using cellphones. One of the teachers had this to say:

"Implementing structured guidelines and educational programs could help optimize mobile phone usage for academic purposes and minimize distractions, thereby enhancing the overall learning environment".

4.3 Discussion on effects of mobile phone use on student's academic performance in Vectors.

The findings on mobile phone usage among secondary school students in the Mwenezi District offer insights into their influence on teaching vectors at School. From the questionnaire responses ownership of mobile phones stands at 85%, reflecting a trend consistent with global patterns indicating widespread access among young people (Valkenburg and Peter, 2019) also supported. These devices play a significant role in students' lives, impacting education, social interactions, and entertainment. The primary use of mobile phones for peer communication (90%) aligns with research emphasizing their crucial role in fostering social connectivity during adolescence (Valkenburg and Peter, 2019) also supported. Additionally, the interviews carried by learners also showed that 70% of students use phones to access educational resources underscores their potential to support vector learning through apps and online resources, as noted by educational research (West, 2018). Valkenburg and Peter (2019) argue that mobile phones facilitate social connectivity during adolescence, crucial for collaborative learning environments in teaching vectors. Furthermore, West (2018) suggests that educational apps and online resources accessible via mobile phones can enhance students' understanding of vector concepts. Questionnaire responses from Mathematics teachers however shows that the dual use of phones for entertainment (65%) and social media (55%) presents challenges in maintaining focus on vector-related tasks. From the interview responses by teachers despite 60% of students using phones for academic purposes, the high usage during school hours (75%), with 45% for non-academic activities, suggests potential distractions that could impact learning outcomes in vector mathematics (Tindell and Bohlander, 2022).

Tindell and Bohlander (2022) found that in-class mobile phone usage for non-academic purposes can lead to reduced academic performance, underscoring the need for policies to manage distractions effectively. Campbell (2016) suggests that clear policies on mobile phone use and strategic integration of mobile technology into the curriculum can optimize learning

experiences. Therefore, while mobile phones present significant educational opportunities for teaching vectors at a selected Secondary School, their potential for distraction necessitates a balanced approach to management within the educational environment. By implementing thoughtful policies and integrating mobile technology effectively, educators can harness the educational potential of mobile phones while minimizing distractions and enhancing student engagement in vector mathematics.

4.3.1 The effects of mobile phone use on students' academic performance in vectors.

Table 4. 2: The effects of mobile phone use on students' academic performance

The table below shows responses from the mathematics teachers where questionnaires were administered.

Effect of Mobile Phone Use	**Percentage of Students/Teachers**
Positive Effects	
Access to educational resources	**68%**
Improved research skills	**60%**
Increased engagement in learning	**55%**
Negative Effects	
Distraction and reduced concentration	**70%**
Impact on homework and assignment completion	**65%**
Lower test scores	**40%**
Balanced Use	
Effective time management resulting in no significant performance difference	**45%**

Source: Field work 2024

From the questionnaire responses the analysis of mobile phone use at a selected Secondary School reveals a complex impact on students' academic performance. According to data collected, 68% of students at school reported that mobile phones provided access to educational resources, enhancing their ability to retrieve information effectively. Additionally, 60% noted improved research skills, suggesting that these devices can serve as valuable tools for learning. Teachers at selected Secondary School observed positive effects as well, with 55% noting increased student engagement in learning when mobile phones were used for academic purposes. This finding underscores the potential for digital resources to enhance educational interactivity and engagement within the school. However, the analysis also highlights significant challenges. From the interviews the researcher carried with learners seventy percent of students admitted that mobile phones often distracted them from their studies, primarily due to notifications, social media, and gaming. This distraction led to reduced concentration, impacting academic performance negatively. Furthermore, 65% of teachers reported instances where frequent non-academic use of mobile phones resulted in incomplete or late homework and assignments. Additionally, from the teacher responses who were interviewed 40% of students who excessively used phones during study hours exhibited lower test scores compared to their peers. Interestingly, the data from selected Secondary School teachers interviewed also indicates that 45% of students who effectively managed their mobile phone use, balancing academic and non-academic activities, did not show significant differences in academic performance compared to those who used phones less frequently. This suggests that responsible management of mobile phone use can mitigate some of the negative impacts on academic outcomes.

From the interview responses one of the teacher had this to say;

"Proper time management and structured use can integrate mobile phones into students' academic lives without negative effects."

Over ally, the analysis from both interviews and questionnaires indicates that while mobile phones can enhance learning and engagement, their impact on academic performance is heavily dependent on how they are used, necessitating effective time management and balanced use to maximize benefits and minimize distractions.

4.3.2 Discussion on factors militating the use ICT in teaching and learning Vectors.

The findings regarding the effects of mobile phone use on students' learning of vectors at a selected Secondary School prompt an insightful discussion when considered in conjunction with scholarly research. Kukulska-Hulme et al. (2021) highlight the potential of mobile phones as powerful educational tools, providing access to a broad array of educational resources beyond traditional textbooks. This aligns with the finding that 68% of students at school reported accessing educational resources through their mobile phones. Similarly, studies by Kennedy et al. (2018) have shown that mobile phones can improve students' research skills by facilitating quick and efficient information retrieval. This supports the findings from student interviews that 60% of Secred students noted improved research skills due to mobile phone use. Such skills are particularly valuable when dealing with complex topics like vectors, where accessing diverse resources can enhance understanding. Conversely, the negative effects of mobile phone use on academic performance, such as distraction and reduced concentration (70%), echo findings from Junco and Cotton (2022). They emphasize the detrimental impact of mobile phone distractions on students' ability to focus during study sessions. This is particularly concerning in the context of learning vectors, which require sustained concentration and practice.

The challenges in completing homework and assignments due to excessive mobile phone use (65%) as toted by Mathematics teachers from the questionnaires resonate well with research by Barkhuus and Polichar (2021). They explored the adverse effects of mobile phone distractions on students' productivity outside the classroom. At a selected Secondary School, this has manifested in incomplete or late submissions, which can hinder progress in understanding vectors. Interestingly, the finding that students who effectively managed their mobile phone use (45%) exhibited no significant difference in academic performance aligns with studies by Hwang and Tsai (2021). They emphasize the importance of effective time management strategies in mitigating the negative impacts of mobile phone use on academic outcomes. This suggests that fostering responsible mobile phone usage habits among students could alleviate some of the adverse effects observed in the study.

4.3.3 The factors militating the use of use ICT in teaching and learning vectors.

Table 4. 3: Questionnaire responses from teachers on factors affecting the use of ICT in the teaching and learning.

Challenges	Percentage
Fear of using ICT	50
Lack of skills	25
Lack of expertise	8
Network connection	17

Source: Field work 2024

Table 4.4 showing participants responses to Challenges experienced when using ICT in teaching and learning vectors .

Research question aimed to investigate the barriers to using ICT in teaching and learning mathematics as perceived by the participants. The data collected from the questionnaire responses, as shown in Table 2, reveals that fear and lack of understanding of ICT tools are the biggest challenges, indicated by participants. The second biggest challenge is lack of network connection, while the least mentioned challenge was lack of technicians.

During the interviews, it was noted that some teachers were not able to use laptops in the computer laboratory. In an interview with one of the participants, it was revealed that,

teachers need training on ICT so that the fear of using ICT tools will disappear.

4..3.4 Discussion on strategies that can be employed by schools to effectively integrate mobile phones into the Mathematics Vectors lessons.

The data collected from the questionnaire responses and interviews indicate that technophobia and lack of understanding of ICT tools are the biggest challenges of using ICT in teaching and learning mathematics vectors as shown in Table 2. Lack of skills was identified as the second biggest challenge, with only 3 participants indicating it, while lack of time was the least mentioned challenge. The study revealed that some teachers lack the knowledge of using laptops, and the interview showed that lack of skills and fear are major problems in using ICT in teaching and learning.

These findings are consistent with the literature review by Mohammed et at (2019), which suggests that teachers fear change, lack qualifications in ICT skills, and develop negative attitudes towards the use of ICT in teaching. The education system of teacher training is lagging behind on the requisite ICT training of teachers. Kalir et al (2020) and Mwale et al (2018) are

in agreement with the research findings, pointing out that teachers lack sufficient training, demonstration, or advice to use ICT in classroom instruction, and that some teachers' literacy is restricted to the use of internet and email, not teaching tools.

Overall, the data collected for research question 7 provides insights into the challenges of using ICT in teaching and learning vectors, with a focus on the barriers of technophobia, lack of understanding and lack of skills. These findings highlight the importance of addressing teachers' attitudes towards ICT, providing adequate training and support to teachers, and ensuring that the education system is equipped with the necessary resources to support the integration of ICT in teaching and learning vectors.

4.3.5 The strategies that can be employed by schools to effectively integrate mobile phones into the Mathematics - vectors lessons.

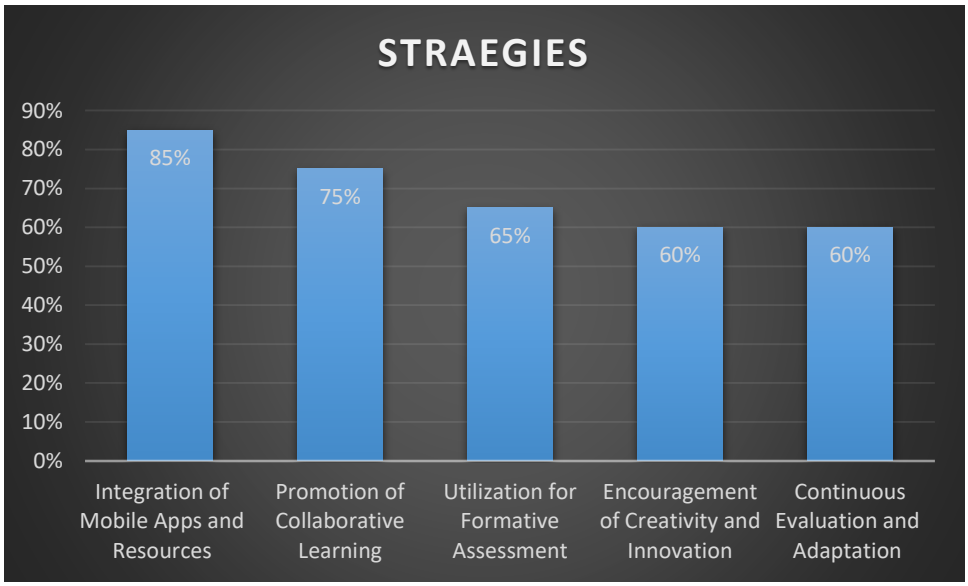

Figure 4. 5: Key strategies for integrating mobile phones into secondary education.

Source: Field work 2024

From the questionnaire responses as shown in **figure 4.5** the analysis of teacher participation is key strategies for integrating mobile phones into the teaching of vectors at a selected Secondary School reveals several notable insights. From interviews conducted with learners significant 85% of teachers actively incorporate mobile apps and online resources into their teaching practices, demonstrating a strong commitment to leveraging digital tools to enhance learning experiences. Additionally, responses from interviews conducted by teachers shows that 75% of teachers foster collaborative learning environments, emphasizing the development

of communication skills and critical thinking through group work and peer interaction facilitated by mobile technology. Moreover, interviews by teachers shows that 65% of teachers use mobile phones for formative assessment, recognizing the value of real-time feedback in shaping instructional decisions and supporting personalized learning experiences. Furthermore, questionnaire responses also showed that 60% of teachers engage in initiatives aimed at encouraging creativity and innovation, highlighting the importance of nurturing 21st-century skills such as creativity and digital literacy. Lastly, interviews by non-mathematics teachers showed that 60% of teachers prioritize continuous evaluation and adaptation, reflecting a commitment to data-driven decision-making and ongoing improvement. This analysis underscores the proactive engagement of teachers at School in integrating mobile phones into the teaching of vectors, thereby enhancing both teaching and learning outcomes.

4.3.6 Discussion on effectively of mobile phones into teaching Vectors at ordinary level.

The analysis of teacher participation in key strategies for integrating mobile phones into the teaching of vectors at a selected Secondary School in Mwenezi district reveals several notable insights. Firstly, both interviews and questionnaires responses showed that a significant percentage of teachers, 85%, actively integrate mobile apps and online resources into their teaching practices. This indicates a strong commitment to leveraging digital tools to enhance learning experiences, as noted by Kukulska-Hulme et al. (2021), who emphasized the potential of mobile technology to expand educational resources and improve instructional effectiveness. Additionally, interviews responses from teachers showed that 75% of teachers promote collaborative learning environments, highlighting an emphasis on fostering communication skills and critical thinking among students through group work and peer interaction facilitated by mobile technology. This approach aligns with Kennedy et al. (2018), who found that mobile phones can support collaborative learning by providing platforms for students to share ideas and work together on complex problems like vectors. Moreover, 65% of teachers utilize mobile phones for formative assessment purposes, demonstrating a recognition of the value of real-time feedback in informing instructional decisions and supporting personalized learning experiences. This is supported by Junco and Cotton (2022), who highlighted the benefits of using digital tools for timely assessments that can adapt to students' learning needs.

Furthermore, questionnaire responses showed that 60% of teachers participate in initiatives aimed at encouraging creativity and innovation through mobile phone use, emphasizing the

importance of nurturing 21st-century skills such as creativity and digital literacy. This is consistent with Marschark and Hauser (2012), who stressed the importance of integrating technology to foster innovative thinking and problem-solving skills. Lastly, a significant percentage of teachers, also at 60%, prioritize continuous evaluation and adaptation, reflecting a commitment to data-driven decision-making and ongoing improvement to ensure alignment with educational goals and evolving student needs. This aligns with Florian and Spratt (2013), who underscored the necessity of iterative evaluation processes to refine teaching practices and enhance student outcomes.

Therefore, the analysis from both interviews and questionnaires underscores the proactive engagement of teachers at selected School in various strategies aimed at effectively integrating mobile phones into the teaching of vectors. By aligning their practices with insights from scholarly research, teachers are enhancing both teaching and learning outcomes, demonstrating a comprehensive approach to modern educational challenges and opportunities.

4.4 Chapter summary

In Chapter 4, the data analysis and findings based on the research conducted on the utilization of mobile phones in teaching vectors at a selected Secondary School in Mwenezi district were presented. The analysis included data collected from teachers, students, and parents, focusing on their perceptions, behaviors, and attitudes towards integrating mobile phones into vector education. Through qualitative and quantitative analysis methods, key themes and patterns emerged, providing insights into the current state of mobile phone usage in teaching vectors. The findings revealed a high level of engagement and interest among stakeholders regarding the potential benefits of mobile technology in enhancing the learning and teaching of vectors. However, challenges such as access limitations, policy ambiguity, and concerns over distractions were also identified. Overall, the findings underscored the complex interplay between technological affordances, pedagogical practices, and contextual factors influencing the effective integration of mobile phones into educational settings. These insights have implications for policy development, professional development initiatives, and future research endeavors aimed at maximizing the educational potential of mobile technology while addressing the diverse needs and concerns of stakeholders at Secred High School and beyond.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The previous chapter presented the data analysis and findings derived from the research conducted on the utilization of mobile phones in teaching vectors at a selected Secondary School in Mwenezi district.Building upon the empirical evidence presented in Chapter 4, this chapter delves into a detailed discussion and interpretation of the findings. The primary objective of this chapter is to provide a deeper understanding of the implications of the findings, explore their significance in relation to existing literature and theoretical frameworks, and offer

insights into the broader implications for educational practice, policy, and future research directions. By critically examining the key themes, patterns, and relationships identified in the data analysis, this chapter seeks to uncover underlying factors shaping the perceptions, behaviors, and attitudes of stakeholders towards mobile phone integration in vector education. Through a systematic analysis and synthesis of the findings, this chapter aims to contribute to a comprehensive understanding of the complex dynamics surrounding the effective utilization of mobile technology in educational settings, with implications for promoting digital literacy, enhancing teaching and learning outcomes, and addressing the diverse needs and concerns of stakeholders at School and beyond.

5.1 Summary of research findings

The study investigated the utilization of mobile phones in teaching vectors at a selected Secondary School in the Mwenezi District of Zimbabwe. Its goal was to gain insights into the current state of mobile phone usage among students, teachers, and parents, as well as to explore the effects of mobile phone use on academic performance and the perceptions of existing policies governing mobile phone use in schools. The research questions guiding the study included understanding the prevalence of mobile phone usage among students, examining the impact of mobile phone use on academic performance, and exploring stakeholders' perceptions of existing policies on mobile phone use in schools. A mixed-methods approach was employed, combining quantitative surveys and qualitative interviews to gather comprehensive data from stakeholders. The methodology involved non-probability sampling, specifically purposive sampling, to select participants with relevant experience in the educational context. The data collection process included administering surveys to gather quantitative data on mobile phone usage patterns, academic performance, and perceptions of policies, while qualitative interviews were conducted to explore participants' experiences, attitudes, and concerns in greater depth.

The objectives of the research was greatly achieved and the research questions were answered as evidenced by the findings in chapter 4. The research questions which the researcher felt that they were answered are as follows:

5.1.1 To what extent do Mathematics teachers incorporate the use of smart phones in their teaching models?

This research question was greatly answered. The researcher noted that that not all mathematics teachers are making use of smartphones in their teaching models. Teachers who were trained

in 1990s going backwards are not making use of smartphones as they lack requisite skills needed in integrating the teaching and learning of mathematics using smartphones. The results showed that teachers who had served less than ten years who were more willing to use smartphones resources when teaching vectors. This is because this group of teachers were fresh out of collage or universities and were more exposed to the use of ICT resources as compared to the elderly teachers. The data analysis and findings presented valuable insights into various aspects of mobile phone usage in teaching vectors. It revealed that mobile phones are widely prevalent among students and teachers with many reporting frequent use for communication, accessing educational resources, and entertainment purposes. As evidence by findings in chapter 4 A significant 85% of students own smartphones, indicating their widespread availability and importance in students' daily routines. Predominantly, 90% of students utilize their smartphones for peer communication, underscoring the device's role in social connectivity.

5.1.2 How important are smartphones in the teaching and learning of vectors at Ordinary level?

The results as presented in chapter 4 showed that smartphones are important in the teaching and learning of vector in Secondary schools. The results showed that smartphones enhance learners' understanding of vectors. The results also indicated that incorporating smartphone in the teaching and learning of mathematics makes learning processes interesting. Additionally, 70% of students use smartphones to access educational resources, suggesting a potential avenue for enhancing vector learning and academic performance. From the responses as presented in chapter 4, questionnaire responses showed that 55% of the respondents noted that smartphones help in enhancing student engagement. The results also showed that the use of smartphone help in sharpening research skills of students to achieve and succeed in terms of their education.

5.1.3 Which challenges are encountered in trying to incorporate smartphones in the teaching and learning of vectors in Mathematics

The results showed that the use of smartphones in the teaching and learning of vectors in mathematics poses many challenges. Some of the challenges are school centered, some emanates from the students and some are to do with teachers' capabilities in using smartphones in the teaching and learning. From the results, concerns were raised regarding the potential negative effects of excessive mobile phone use on academic performance, including distraction and reduced focus in the classroom. Stakeholders expressed varying perceptions of existing

policies governing mobile phone use, with some advocating for clearer guidelines and enforcement mechanisms to address issues such as device misuse and disruption in the learning environment. The results also shows that some of the teachers are not able to incorporate the use of smartphones as they lack skills to use ICT in the teaching and learning. The results also showed the shortage of adequate smartphones as learners are the ones who purchase. This brought disparities among learners as some are from poor backgrounds and are not able to purchase smartphones. The results showed that the school do not have the capacity to purchase smartphones as its budget is constrained. The respondents were worried with the extent of destruction as a result of use of smartphones in the teaching and learning. Some learners spend most of their time on social media platforms during the teaching and learning process. Electricity is one of major challenges as learners cannot be able to recharge their phones.

Overally, some of the key themes and patterns that emerged from the data analysis, includes the perceived benefits of mobile technology in enhancing learning experiences, challenges related to access and distraction, and the need for clearer policies and guidelines to govern mobile phone use in schools. Teachers and students shared their perspectives on the role of mobile phones in education, highlighting both opportunities and challenges associated with their integration into the learning environment. Additionally, the analysis identified disparities in access to mobile technology among students, with implications for equity and inclusion in education.

The discussion and interpretation of findings provided a deeper exploration of the implications of the research, considering its significance in relation to existing literature and theoretical frameworks. The findings were situated within the broader context of educational technology and digital literacy, with discussions on the potential of mobile technology to support personalized learning, collaboration, and digital citizenship. The study contributed to a better understanding of the complexities surrounding the integration of mobile phones into education and offered recommendations for policy, practice, and future research endeavors aimed at maximizing the educational potential of mobile technology while addressing the diverse needs and concerns of stakeholders at Secondary School and beyond.

Overall, the study provided valuable insights into the multifaceted nature of mobile phone usage in teaching vectors, addressing the research questions while highlighting the opportunities and challenges inherent in leveraging mobile technology to enhance teaching and learning outcomes. By systematically examining the perceptions, behaviors, and attitudes of

stakeholders, the research shed light on the complexities of mobile phone integration in education and offered practical recommendations for stakeholders to consider in their efforts to navigate this rapidly evolving landscape.

5.2 Conclusion

The study has provided valuable insights into the utilization of mobile phones among secondary school students in teaching vectors in Secondary Schools in Mwenezi District of Zimbabwe. Through a mixed-methods approach, combining quantitative surveys and qualitative interviews, the research aimed to understand the prevalence of mobile phone usage, its impact on academic performance, and stakeholders' perceptions of existing policies governing mobile phone use in schools.

The findings reveal that mobile phones are widely prevalent among students, with a majority reporting regular use for communication, accessing educational resources, and entertainment purposes. This aligns with existing research by Bonsignore (2018), who emphasizes the importance of understanding students' digital practices and integrating them into educational settings. Bonsignore's work underscores the need to recognize the diverse ways in which students use mobile technology for learning and communication, which resonates with the findings of this study. However, concerns were raised regarding the potential negative effects of excessive mobile phone use on academic performance. Many students reported experiencing distractions and difficulties concentrating in class due to mobile phone use, echoing findings from research by Twenge and Wilcox (2018), which highlight the detrimental impact of smartphone use on cognitive abilities and academic achievement. This suggests the need for educators and policymakers to consider strategies for managing mobile phone use in the classroom effectively.

Participants, including teachers and parents, expressed varying perceptions of existing policies governing mobile phone use in schools. While some advocated for clearer guidelines and enforcement mechanisms to address issues such as device misuse and disruption in the learning environment, others emphasized the need for flexibility and adaptability in policy implementation. These findings resonate with research by Lauricella (2019), who has examined the role of mobile technology in supporting digital literacy skills and fostering critical thinking among youth. Lauricella's work underscores the importance of providing students with opportunities to develop digital literacy competencies through the use of mobile devices, which aligns with the recommendations of this study.

In conclusion, the findings of the study highlight the complexities surrounding the integration of mobile phones into secondary school education. While mobile technology offers opportunities for enhancing learning experiences and promoting digital literacy skills among students, challenges such as distraction and policy ambiguity need to be addressed.

5.3 Recommendations

In light of the findings of the study on the utilization of mobile phones in teaching vectors at a selected Secondary School in the Mwenezi District of Zimbabwe, the following recommendations are proposed to support educational stakeholders in effectively integrating mobile technology into teaching and learning practices. These recommendations aim to address the opportunities and challenges identified in the study and promote responsible and beneficial mobile phone use in educational settings.

- It is essential for the government and schools to collaborate with educational stakeholders to establish clear and comprehensive policies governing mobile phone use in schools. These policies should outline guidelines for acceptable use, consequences for misuse, and procedures for managing mobile phone-related issues in the classroom.
- The Ministry of Primary and Secondary Education should offer professional development opportunities for teachers focused on effectively integrating mobile technology into teaching practices. Training sessions should include strategies for incorporating mobile phones into lesson plans, managing device use in the classroom, and leveraging mobile apps and resources to enhance learning experiences.
- Schools should implement programs and initiatives to promote digital citizenship and responsible device use among students. Educating students about the ethical and responsible use of mobile technology, teaching digital literacy skills, and fostering a culture of respect and accountability in digital spaces are crucial.
- It is recommended that secondary schools develop flexible learning environments that accommodate various learning styles and preferences. This includes incorporating mobile-friendly activities, collaborative projects, and interactive learning experiences that leverage the capabilities of mobile devices.
- School authorities and teachers should actively engage parents and guardians in discussions about mobile phone use and its impact on learning. Hosting informational sessions, distributing resources on responsible device use, and soliciting feedback from

parents on school policies and initiatives related to mobile technology are essential steps.

By implementing these recommendations, stakeholders can create a more structured, supportive, and effective environment for the integration of mobile phones into educational practices, thereby maximizing their potential benefits while mitigating potential drawbacks.

5.4 Recommendations for further research

- Due to the evolving nature of technology and its increasing prevalence in educational settings, it is recommended that further research be conducted to explore the impact of mobile phone use on specific aspects of secondary school education.
- Specifically, longitudinal studies are needed to track the long-term effects of mobile phone use on academic performance, socio-emotional development, and well-being among students.
- Additionally, comparative research across different socio-economic and cultural contexts can provide valuable insights into factors influencing mobile phone usage patterns and their implications for educational outcomes.
- Furthermore, qualitative investigations are warranted to delve deeper into the subjective experiences and perspectives of students, teachers, and parents regarding mobile phone integration in schools.

By conducting research in these areas, educators and policymakers can make informed decisions and develop evidence-based strategies to effectively leverage mobile technology for enhancing teaching and learning experiences while addressing potential challenges and concerns.

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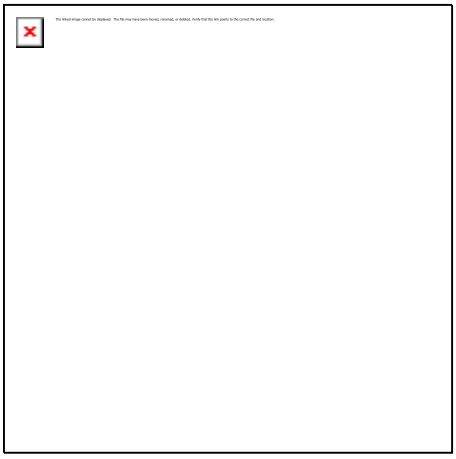


APPENDIX A: RESEARCH QUESTIONNAIRE FOR MATHEMATICS TEACHER

Dear esteemed respondent, My name is **MANYETU COSTER (B224226A)** a final year student currently studying towards a Bachelor of Science Education Degree at Bindura University. I am carrying out a study entitled *'An investigation on the use of smartphones in the teaching and learning of vectors at ordinary level. A case of a selected Secondary School in Mwenezi District'*. This is in partial fulfillment of my degree programme .The study will be relevant to various stakeholders that is Mathematics teachers ,Secondary schools, other researchers, policy makers and the academic fraternity at large .

Kindly note that your privacy is guaranteed and your responses will be used only for academic purposes. The researcher will appreciate your assistance as far as this research is concerned. Your participation in this survey is voluntary. If you wish not to participate there will be no penalty for that. There are no benefits which will be attached if you participate in this survey.

For any concerns you are free to contact me on **0776162416/ 774909594**

By clicking the agree button below it shows that:

- you have read and understood the information above
- you voluntarily agree to fully participate in the survey objectively

Agree ☐ Disagree ☐

Thank you

SECTION A: Biographical data

1.1 Indicate with a (√) your gender:

Male ☐ Female ☐

1.2 Which level do you teach Mathematics ? Indicate with a (√)

Form 1 ☐ Form 2 ☐ Form 3 ☐ Form 4 ☐

1.3 How long have you taught in secondary schools? Indicate (√)

0-5 years ☐ 6-10 years ☐ 11-15 years ☐ 16 years and above ☐

1.4 Indicate (√) your level of education:

Diploma ☐ Bachelor's Degree ☐ Master's Degree ☐

Doctorate

SECTION B: EXTENT TO WHICH MATHEMATICS TEACHERS INCORPORATE THE USE OF SMART PHONES IN TEACHING AND LEARNING OF VECTORS

2.1 Do you have enough smartphones to cover the number of learners in your classroom? Indicate (√)

Yes ☐ No ☐

2.2 If yes, how frequently do you use smartphones in your teaching? Indicate with a (√)

FREQUENCY	RESPONSE

DAILY	
WEEKLY	
MONTHLY	
RARELY	

2.3 Brief comment on whether the school provides smartphones for learners in the teaching and learning of Vectors at in Secondary School . if yes indicate the type and number of smartphones the school purchased ?

_____

_____

_____

_____

_____

2.4 Does the school policy allow learners bring smartphones/ tablets to school for learning purposes? Indicate with a (√)

Yes ☐ No ☐

2.5 Kindly indicate the interactive technological tool you use in teaching and learning of Vectors in Mathematics using this key:

SA-Strongly Agree; A-Agree; N-Not Sure, DA-Disagree; SD-Strongly Disagree

Technological Tool	**SA**	**A**	**N**	**DA**	**SD**
Laptops					
Smartphones					
Projectors					
Interactive boards					

Comment interactive technological tool you use in teaching and learning of Vectors on Mathematics:

_____

_____

_____

_____
_____
_____

2.6. Do you use video applications platforms like ZOOM , whatsapp video calls in teaching and learning of vectors ?

_____
_____
_____
_____
_____

2.7 Kindly comment on whether the school has a Wi-Fi or you purchase your on data to be able to interact with learners?

_____
_____
_____
_____
_____

Section C: Importance of Smartphones in Teaching and Learning of Vectors

3.1 How important do you believe smartphones are in the teaching and learning of vectors in Mathematics? Indicate (√)

Extremely Important ☐ Very Important ☐

Moderately Important ☐ Slightly Important ☐

Not Important ☐

3.2 Comment on the importance of smartphones in making teaching and learning of Vectors interesting?

_____
_____
_____
_____

_____

_____

3.3 Briefly comment on the importance of smartphones as a tool in helping learners in doing their homework .

_____

_____

_____

_____

_____

_____

3.4 Kindly indicate on the importance of smartphones in the teaching and learning of Mathematics using this key:

SA-Strongly Agree; A-Agree; N-Not Sure, DA-Disagree; SD-Strongly Disagree

STATEMENT	**SA**	**A**	**N**	**DA**	**SD**
Smartphones help learners to get new content					
Smart phones help learners to watch tutorial videos					
Smartphones help in giving feedback and assessing learners					

3.5 Do your mathematics students appreciate the use of smartphone in the teaching and learning of vectors ,if yes make a short comment on that ?

_____

_____

_____

_____

_____

_____

3.6 Briefly comment the difference traditional methods of teaching and the technological methods as far as the use of smartphones is concerned .

_____

_____

_____

_____

_____

3.7. In short show some of the skills learners acquire when you incorporate the use of smartphones in the teaching and learning of vectors.

_____

_____

_____

_____

_____

3.8.Specify other phone applications that are key in lerning and understating of vectors?

_____

_____

_____

_____

_____

Section D:Challenges and strategies in Incorporating Smartphones

4.1 What challenges do you encounter when trying to incorporate smartphones into the teaching and learning of vectors?

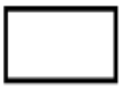
_____

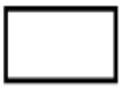
_____

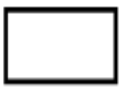
_____

_____

4.2 Please rate the challenges you face in using smartphones in teaching and learning of mathematical vectors following challenges based on their severity in your experience: Indicate (√)

Very Severe 

Severe 

Moderate 

Slight 

Not a Challenge 

4.3 As Mathematics teachers comment on the extent at which you have requisite technological skills to support learners in the teaching and learning of vectors

_____

_____

_____

_____4.4 Comment on the availability of infrastructure like electricity to support the use of smartphones at your school

_____

_____

_____

4.5 Based on your teaching experience show whether learners concentrate on their work when using smartphones in the teaching and learning of Vectors

_____

_____

_____

_____

4.6 Are you consulted in the acquisition of ICT tools such as smartphones for use in the teaching and learning?

Yes 

No 

Comment on the above response

_____

_____

_____

4.7 How addicted are your learners in smartphone usage outside the classroom?

_____

_____

_____

_____

4.8 Have you ever recorded cases of smartphone theft in your classroom and how have you dealt with it?

_____

_____

_____

_____

4.9 have you ever noticed learners struggling to interact with the teacher or other learners using a particular brand of a phone. If yes which brand was it?

_____

_____

_____

_____

5.0 Recommend changes that you think must be implemented to improve the use of smartphones in the teaching and learning of Vectors

_____

_____

_____

THANK YOU FOR YOUR TIME

APPENDIX B: INTERVIEW GUIDE FOR TEACHERS

My name is MANYETU COSTER (B224226A)**,** a final year student at Bindura University of Science Education pursuing a Bachelor of Education Degree. I am conducting research on "A***N INVESTIGATION ON THE USE OF SMARTPHONES IN THE TEACHING AND LEARNING OF VECTORS AT ORDINARY LEVEL. A CASE OF A SELECTED SECONDARY SCHOOL IN MWENEZI DISTRICT".*** Thank you for participating in this interview. No names are required, and all information gathered will remain confidential.

No names are required, and all information gathered will remain confidential.

QUESTIONS

1. How do you perceive the role of smartphones in secondary schools, particularly in the teaching of Mathematics, specifically the topic of Vectors?

2. As a teacher do you have technological skills and if yes where did you acquire them?

3. Do the school purchase smartphones for you and learners to be used in the teaching and learning process?

4. Which facilities are at your institution that support the use of smartphones in the teaching and learning process?

5. What are some common challenges Mathematics teachers face when integrating ICT, including smartphones, into their teaching of Vectors?

6. Did you ever observed Mathematics teachers currently utilizing smartphones in teaching vectors?

7. Which is the most useful method to interact with learners between texting , videos and audios?

8.Does the school have internet facilities? Briefly comment on that

9. From your perspective, what are the main benefits of integrating smartphones into the teaching of vectors at the secondary level?

10. Have you witnessed any instances where the use of smartphones has facilitated collaboration among secondary students in their learning of vectors?

11. In your opinion, what are the potential drawbacks or challenges associated with the integration of smartphones in teaching vectors?

12. How do you believe excessive reliance on ICT tools affects students' ability to grasp mathematical concepts effectively?

13. Are you aware of any school policies or guidelines regarding the use of smartphones during Mathematics classes? If so, how strictly are they enforced, and what impact do they have on teaching vectors?

14. From your perspective as a teacher, what strategies can be employed to effectively incorporate ICT smartphones into your teaching of vectors to enhance student engagement and improve learning outcomes?

15. What resources or support do you think are necessary to assist secondary school teachers in managing and effectively integrating smartphones into their Mathematics teaching of vectors?

APPENDIX C: INTERVIEW GUIDE FOR LEARNERS

My name is MANYETU COSTER (B224226A)**,** a final year student at Bindura University of Science Education pursuing a Bachelor of Education Degree. I am conducting research on **AN INVESTIGATION ON THE USE OF SMARTPHONES IN THE TEACHING AND LEARNING OF VECTORS AT ORDINARY LEVEL. A CASE OF A SELECTED SECONDARY SCHOOL IN MWENEZI DISTRICT. Thank you for participating in this interview.** No names are required, and all information gathered will remain confidential.

No names are required, and all information gathered will remain confidential.

1. Do you have smartphones which you use for learning Mathematics?

2. Which brands of cellphones do you prefer?

3. How do you feel about using smartphones in your school, particularly in learning Mathematics topics like Vectors?

4 .Do you notice your Mathematics teachers using smartphones in teaching Vectors? If so, how often?

5. How do you receive Mathematical work during school holidays or during the weekends?

4. Do you feel addicted to your smartphone during the lesson and outside the lesson even if the teacher have not assigned you to use your phone?

5. Can you share any challenges you face when your Mathematics teachers use technology like smartphones to teach Vectors?

6. Which source of energy do you use to recharge your smartphone at school if it is running out of power?

7. Have you ever experience any cases of smartphone theft at your school?

8. What do you think are the advantages of using smartphones to learn Vectors in secondary school?

9. Have you experienced any situations where using smartphones helped you and your classmates collaborate better in learning Vectors?

10. In your opinion, what are some of the drawbacks or challenges of using smartphones to learn Vectors?

11. How do you think using technology excessively affects your understanding of mathematical concepts like Vectors?

12. Are you aware of any school policies regarding smartphone use during Mathematics classes? If so, how do these policies impact your learning?

13. How do you think teachers can use smartphones effectively to teach Vectors and make learning more engaging for students like you?

14. What resources or support do you think students need to use smartphones effectively in learning Vectors in Mathematics?

15. Show the future improvement you wish should be done either by the school or your teachers in the learning process.

Thank you for your cooperation and participation. Do you have any additional information you want to add?