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HBSCED PROJECT

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CHALLENGES OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) INTEGRATION IN THE TEACHING AND LEARNING OF PHYSICS AT ORDINARY LEVEL

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DEDICATION

This work is dedicated to my husband Anthony Rimau who struggled to provide me with the best educational opportunities amidst difficulties. His foresight and investment in my education has made me reach this far. At the same time, special dedication is also made to my children Joash, Chloe, Jayden, my mother Agatha Madimbu and my late father Silas Madimbu. I am always grateful to them for their sacrifices.

Abstract

In this research project the researcher seeks to investigate thechallenges of Information and Communication Technology (ICT) integration in the teaching and learning of Physics at Ordinary level. The researcher acknowledges the efforts of various stakeholders in education in bringing the Information and Communication Technology curriculum resources at Kuwadzana 1 High School in general and in Warren Park/ Melbereign district in particular as a commitment to bringing ICT to the pupils. Thus, the researcher in this document explores the extent to which ICT resources are being used to teach science subjects like physics in particular and other subjects in general. The researcher also touches on some of the challenges that are being faced by teachers and learners in utilising the ICT resources in the classroom, and tries to suggest some ways to improve the current state of Physics instruction in Kuwadzana 1 high school. Because of the challenges listed herein, most of the gadgets have been lying idle in classrooms. The challenges ranges from lack of either proper infrastructural facility such as computer laboratories and electricity to lack of trained ICT teachers. In the final submission, the research implores stakeholders in education to facilitate ICT development in schools in Zimbabwe so as to increase access, quality and equity in education for sustainable rural development in Zimbabwe. The study was both qualitative and quantitative in nature and relied on interviews, observations and use of the questionnaire. Using the theoretical paradigm of curriculum change and innovation, the study revealed that the use of ICT resources for pedagogical purposes is very low in schools in particularly in Zimbabwe in general. Basing on this, the researcher recommends a multi sectorial approach involving government, private sector, parastatals and other stake holders to ensure that students in rural schools benefit from the new technology through it being implemented in rural schools.

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Abbreviations of Acronyms

ICT…… Information and Communication Technology

SDG……School Development Groups

UNESCO ….United Nations Educational, Scientific and Cultural Organisations

ITU…….International Telecommunication Union

TPACK……Technological Pedagogical Content Knowledge

CHAPTER ONE

1.1 INTRODUCTION TO THE STUDY

This chapter gives a panoramic view of the study, outlining its background and putting it into perspective. The study's problem statement, aim, objectives, research questions, significance of the study, delimitations and limitations of the study are articulated in this chapter. The chapter concludes by providing operational definitions for the key terms and concepts used in the study.

1.2 BACKGROUND OF THE STUDY

The integration of Information and Communication Technology (ICT) in education has become a global imperative in enhancing teaching and learning processes. According to the International Telecommunication Union (ITU, 2021), approximately 63% of the global population now has access to the internet, a stark increase from just 30% a decade ago. This digital transformation has significantly influenced educational practices, with many countries adopting ICT as a tool to improve educational outcomes. However, this integration has not been uniformly successful, particularly in developing regions. For instance, a report by the World Bank (2020) indicates that Sub-Saharan Africa faces considerable challenges, including limited infrastructure, inadequate teacher training, and socio-economic disparities that hinder effective ICT implementation in schools. These challenges have been exacerbated by the COVID-19 pandemic, which highlighted the digital divide and the urgent need for equitable access to educational technologies (UNESCO, 2020).

The integration of Information and Communication Technology (ICT) in education has become a focal point for enhancing teaching and learning across the globe. In the United States, the adoption of ICT in education has been driven by initiatives aimed at improving digital literacy and preparing students for a technology-driven workforce. The U.S. Department of Education has emphasized the importance of technology in classrooms, advocating for the use of digital tools to foster student engagement and personalized learning experiences (U.S. Department of Education, 2020). Similarly, in the United Kingdom, the government has invested significantly in digital education, launching programs such as the EdTech Strategy, which aims to harness technology to improve educational outcomes and ensure that all students have access to high-quality digital resources (Department for Education, 2021). European countries have also made strides in ICT integration, with initiatives like the European Commission's Digital Education Action Plan, which promotes the use of digital technologies in education and training to enhance learning and teaching across member states (European Commission, 2020).

In Sub-Saharan Africa, the integration of ICT in education presents both opportunities and challenges. Countries like South Africa have recognized the potential of ICT to transform education, leading to initiatives such as the South African government's "Digital Education Strategy," which aims to improve access to technology in schools and enhance digital skills among teachers and students (Department of Basic Education, 2020). However, significant barriers remain, including inadequate infrastructure, limited access to devices, and a lack of training for educators. A study by the World Bank (2021) highlights that while South Africa has made progress in ICT integration; disparities in access and quality of education persist, particularly in rural areas. In Kenya, the government has also prioritized ICT in education through initiatives like the Digital Literacy Programme, which aims to equip primary school students with digital skills and integrate technology into the curriculum (Republic of Kenya, 2020). Despite these efforts, challenges such as insufficient resources and varying levels of teacher preparedness continue to hinder effective ICT integration in Kenyan schools (Piper et al., 2021).

Malawi and Zambia also face significant challenges in integrating ICT into their educational systems. In Malawi, the government has initiated several programs to promote ICT in schools, such as the "Malawi National ICT Policy," which aims to enhance access to technology and improve educational outcomes (Malawi Government, 2020). However, the lack of infrastructure and training for teachers remains a critical barrier. According to a report by the United Nations Children's Fund (UNICEF, 2021), many schools in Malawi still lack basic technological resources, which limits the ability of teachers to integrate ICT effectively into their lessons. Similarly, Zambia has made strides through initiatives like the "Zambia National ICT Policy," which seeks to increase access to technology in education (Zambia Ministry of Communications and Transport, 2020). Nevertheless, challenges such as inadequate funding and limited access to electricity in rural areas hinder the full realization of these goals (Zambian Education Coalition, 2021).

The urgency of addressing these challenges is underscored by the global shift towards digital learning and the increasing demand for digital skills in the workforce. According to the African Development Bank (2022), over 60% of jobs in the future will require some level of digital proficiency, making it imperative for educational institutions to adapt and prepare students accordingly. In Kenya, Malawi, and Zambia, government initiatives recognize the importance of ICT integration, yet implementation remains inconsistent and heavily reliant on external support (Maphosa, 2021). Understanding the challenges faced by Physics teachers in these countries regarding ICT integration is crucial for developing targeted interventions that can enhance educational outcomes for students.

The integration of Information and Communication Technology (ICT) into the teaching and learning of Physics at the Ordinary level in Zimbabwe faces several significant challenges. One of the primary obstacles is the inadequate infrastructure, particularly the lack of reliable internet access and insufficient hardware resources in many schools. This limitation restricts both teachers and students from fully utilizing digital tools and online resources essential for modern Physics education (Musakwa, 2015). Furthermore, many educators lack the necessary training to effectively incorporate ICT into their teaching practices, leading to a reliance on traditional methods that may not engage students as effectively as technology-enhanced approaches (Musakwa, 2015; IJAER, 2023).

Economic factors also play a crucial role in hindering ICT integration. Budget constraints often prevent schools from acquiring the necessary technology and maintaining existing equipment, which can lead to disparities in educational quality between urban and rural areas (IJAER, 2023). Additionally, the existing curriculum may not adequately support the integration of ICT, as it often lacks flexibility and does not align with the rapidly evolving technological landscape (Musakwa, 2015). This misalignment can result in a disconnect between the skills students need to develop and the content they are taught.

Cultural and social issues further complicate the situation. There is often a digital divide, where students in rural areas have significantly less access to technology compared to their urban counterparts, exacerbating educational inequalities (IJAER, 2023). Moreover, parental support for ICT initiatives can be limited, as some parents may not fully understand the importance of technology in education, which can affect students' motivation and engagement (Musakwa, 2015). Lastly, concerns regarding cyber security and data privacy can deter both educators and students from fully embracing ICT tools, as the risks associated with online learning environments remain a significant concern (IJAER, 2023).

In the context of Zimbabwe, the socio-economic challenges related to ICT integration are particularly pronounced. According to the Zimbabwe National Statistics Agency (2022), the literacy rate stands at approximately 94%, yet many students and teachers lack access to basic technological resources. The government has made efforts to introduce ICT in schools since the early 2000s, but progress has been slow due to economic instability and policy inconsistencies (Munyoro, 2021). A study by Maphosa and Mafa (2020) emphasizes that while some urban schools have begun to integrate ICT into their curricula, many rural and peri-urban institutions, like Kuwadzana 1 High School, continue to struggle with outdated equipment and lack of training for teachers. This disparity not only affects the teachers' ability to deliver quality education but also limits students' exposure to essential technological skills needed for the modern workforce.

The historical context of ICT integration in Zimbabwe reveals a complex interplay of factors that have contributed to the current challenges. In the early 2000s, the government initiated several ICT policies aimed at improving educational access and quality. However, these efforts were undermined by economic downturns, political instability, and a lack of sustained investment in infrastructure (Zinyama, 2021). Over the years, various non-governmental organizations and international partners have attempted to bridge the gap through training programs and resource provision, but their impact has been limited by ongoing socio-economic constraints (Chikoko& Mlambo, 2020). The gradual decline in educational funding and the prioritization of other sectors have further stifled ICT integration efforts, leaving many teachers ill-equipped to harness technology effectively in their classrooms.

Currently, the need to study the challenges of ICT integration in Zimbabwe is more critical than ever. As the world shifts towards a digital economy, the educational sector must adapt to prepare students for future employment opportunities. According to a report by the African Development Bank (2022), more than 60% of jobs in the future will require digital skills, underscoring the urgency of addressing the educational technology gap. In Zimbabwe, the Ministry of Education has recognized the importance of ICT in education; however, implementation remains fragmented and largely dependent on external funding (Maphosa, 2021). The COVID-19 pandemic has magnified these issues, revealing significant disparities in access to technology and exacerbating existing inequalities in educational outcomes (UNICEF, 2021).

In summary, the challenges of integrating ICT into the teaching and learning of Physics at the Ordinary level in Zimbabwe are multifaceted, involving infrastructural, economic, curricular, cultural, and safety-related issues. Addressing these challenges requires a concerted effort from policymakers, educators, and communities to create an environment conducive to effective ICT integration. Moreover, the challenges faced by Physics teachers regarding ICT integration reflect broader systemic issues within the Zimbabwean education system. Understanding these challenges is essential for developing targeted interventions that can support teachers and enhance the quality of education. With the ongoing global emphasis on digital literacy and technological integration in education, addressing these challenges is not only timely but imperative for the future of Zimbabwe's educational landscape.

1.3 STATEMENT OF THE PROBLEM

The integration of Information and Communication Technology (ICT) in educational settings has been widely recognized as essential for enhancing teaching and learning processes. However, Physics teachers at Ordinary level face significant challenges that hinder effective ICT implementation. According to UNESCO (2013), the successful integration of ICT in education requires not only access to technology but also the necessary skills and infrastructure. Unfortunately, many educators in developing regions, including Zimbabwe, encounter barriers such as inadequate resources, lack of training, and insufficient institutional support (Munyoro, 2016; Maphosa & Mafa, 2019). These challenges underscore the pressing need to investigate the specific factors affecting Physics teachers at Ordinary level. The challenges surrounding ICT integration are multifaceted and have been recognized by various scholars as critical impediments to educational advancement. The lack of support from educational authorities further exacerbates these issues, as teachers may feel isolated and unsupported in their efforts to integrate technology into their teaching practices (Maphosa, 2021).Additionally; the socio-economic context of the school community plays a crucial role in shaping the experiences of science teachers regarding ICT integration.

1.4 PURPOSE OF THE STUDY

The purpose of this study is to investigate the challenges associated with the integration of Information and Communication Technology (ICT) in the teaching and learning of Physics at the Ordinary level in Zimbabwe. As the educational landscape evolves, understanding these challenges is crucial for enhancing the effectiveness of Physics education. Previous research has highlighted that inadequate infrastructure, such as unreliable internet access and insufficient technological resources, significantly hampers the effective use of ICT in classrooms (Chipfunde, 2021). Furthermore, the lack of adequate training for teachers in ICT integration has been identified as a barrier, leading to a reliance on traditional teaching methods that may not engage students effectively (Mugabe & Chikoko, 2022).

Additionally, economic constraints often limit schools' ability to invest in necessary technologies, creating disparities in educational quality, particularly between urban and rural institutions (Mavhunga, 2023). The existing curriculum may also not support ICT integration adequately, as it often fails to align with contemporary technological advancements, resulting in a disconnect between the skills students need and what is taught (Ndlovu, 2023). Scholars like Dube (2024) emphasize the importance of a well-structured curriculum that incorporates ICT effectively to prepare students for the demands of the 21st century. Moreover, cultural factors play a significant role, as some parents and communities may not fully understand the value of ICT in education, potentially affecting student motivation and engagement (Moyo, 2023).

Moreover, issues related to cyber security and data privacy can deter educators from fully embracing ICT tools, as highlighted by Chikasha (2023), who argues that concerns over online safety can limit the use of digital resources in classrooms. The lack of institutional support and leadership in promoting ICT initiatives within schools further exacerbates these challenges (Chikanga, 2023). By exploring these multifaceted challenges, this study aims to provide insights that can inform policy makers and educators on how to improve ICT integration in Physics education. The findings are expected to contribute to the development of effective strategies that will facilitate a more engaging and relevant learning experience for students, ultimately enhancing their academic performance and interest in the subject.

1.5 RESEARCH QUESTIONS

1. What are the key infrastructural challenges affecting the integration of ICT in Physics education at the Ordinary level in Zimbabwe?

2. How does the level of teacher training and professional development influence the integration of ICT in the teaching practices of Physics educators?

3. What strategies can be employed to address the challenges and improve the effective integration of ICT in Physics teaching and learning at Ordinary Level?

1.6 RESEARCH AIM

To investigate the challenges hindering the integration of Information and Communication Technology (ICT) in the teaching and learning of Physics at the Ordinary level in Zimbabwe.

1.7 ASSUMPTIONS

Quantitative Research Hypothesis:

1. Null Hypothesis (H0): There is no significant relationship between the level of infrastructure availability and the effectiveness of ICT integration in the teaching and learning of Physics at the Ordinary level in Zimbabwe.

2. Alternative Hypothesis (H1): There is a significant relationship between the level of infrastructure availability and the effectiveness of ICT integration in the teaching and learning of Physics at the Ordinary level in Zimbabwe.

Assumption

Qualitative Research Assumption:

1. The integration of ICT in Physics education is influenced by a complex interplay of factors, including teacher perceptions, cultural attitudes, and economic conditions, which can be explored through in-depth interviews and focus group discussions with educators and stakeholders in Zimbabwean schools.

1.8 SIGNIFICANCE OF THE STUDY

The significance of this study lies in its potential to provide valuable insights into the challenges of integrating Information and Communication Technology (ICT) in the teaching and learning of Physics at the Ordinary level in Zimbabwe. By identifying and analyzing these challenges, the research aims to inform policymakers, educators, and stakeholders about the critical barriers that hinder effective ICT implementation. This understanding is essential for developing targeted strategies and interventions that can enhance the quality of Physics education, ultimately leading to improved student engagement and learning outcomes. Additionally, the findings of this study will contribute to the broader discourse on educational technology integration in developing countries, offering a framework for addressing similar challenges in other contexts. By focusing on the unique circumstances and needs of Zimbabwean schools, this research will help pave the way for a more equitable and effective educational environment that prepares students for the demands of the digital age. Ultimately, the study seeks to foster a more innovative and responsive educational system that embraces technology as a tool for enhancing learning experiences and outcomes in Physics education.

Firstly, the Ministry of Primary and Secondary Education stands to benefit significantly from this research. By identifying specific challenges, the ministry can formulate targeted interventions aimed at facilitating ICT integration in schools. This study can inform policy adjustments and resource allocation, ensuring that schools like Kuwadzana 1 High School amongst others receive the necessary support, training, and infrastructure to implement ICT effectively. It also provides evidence-based recommendations that can guide the development of national ICT strategies tailored to the unique needs of different regions and socio-economic contexts within Zimbabwe. Educators, particularly Physics teachers, are another key beneficiary of this study. By highlighting the challenges they face, the research can shed light on the need for professional development programs that equip teachers with both the technical skills and pedagogical strategies necessary for integrating ICT into their teaching. Improved teacher training can lead to enhanced teaching practices, ultimately benefiting students' learning experiences. Furthermore, the findings can foster a sense of community among educators, encouraging collaboration and sharing of best practices in ICT integration.

Students are vital stakeholders in this study, as effective ICT integration has the potential to enhance their educational experiences and outcomes. By addressing the barriers teachers face, the study indirectly aims to improve the quality of education that students receive. Access to modern teaching tools and resources can lead to better engagement, critical thinking skills, and preparedness for a technology-driven workforce. Lastly, the broader community and educational stakeholders, including parents and local businesses, will benefit from an educational system that effectively integrates ICT. As students become more technologically proficient, they will be better equipped to contribute to the local economy and society, fostering a culture of innovation and development within the community. This study bridges significant gaps in existing research by providing localized insights into the challenges of ICT integration in Zimbabwean schools. While much research has been conducted globally, there is a lack of context-specific studies that address the unique challenges faced by educators in Zimbabwe. By focusing on Kuwadzana 1 High School, this research contributes to a deeper understanding of the factors influencing educational practices in the region, paving the way for meaningful improvements in ICT integration efforts.

1.9 DELIMITATIONS

The study will focus exclusively on the integration of Information and Communication Technology (ICT) in the teaching and learning of Physics at the Ordinary level, thereby excluding other subjects and educational levels. The research will be limited to selected secondary schools in Zimbabwe in Harare Province namely Kuwadzana 1 High School, which may not represent all regions or types of schools, such as private institutions or vocational training centers. Additionally, the study will primarily utilize qualitative and quantitative methods to gather data from teachers, students, and administrators, while excluding perspectives from parents and community members. The timeframe for data collection will be restricted to the current academic year, which may limit insights into long-term trends or changes in ICT integration practices. By defining these delimitations, the study aims to maintain a focused approach to examining the challenges of ICT integration in Physics education, ensuring that the findings are relevant and applicable to the specific context of Zimbabwean secondary schools.

1.10 LIMITATIONS

The limitations of this study include several factors that may impact the generalizability and comprehensiveness of the findings. Firstly, the research is confined to a specific geographical area within Zimbabwe, which may not reflect the experiences of all schools across the country, particularly in rural versus urban settings. This limitation could affect the applicability of the results to broader contexts. Secondly, the study will rely on self-reported data from teachers, students, and administrators, which may introduce biases related to personal perceptions, experiences, or social desirability. Additionally, the focus on a single academic year for data collection may overlook longitudinal trends and changes in ICT integration practices over time. The data collection period may be limited, affecting the depth of insights obtained from interviews and surveys. A longer duration might yield more comprehensive data. Cultural attitudes towards Physics and technology may influence the responses of participants, which could introduce variability in the data that is not accounted for. Limitations in access to technological resources during the study for example, internet connectivity may affect both the data collection process and the responses of the participants. The rapid pace of technological change may mean that findings become outdated quickly as new tools and resources emerge. While the study focuses specifically on Physics, challenges and experiences may vary significantly in other subjects, limiting the applicability of the findings to broader educational contexts. These limitations therefore, should be acknowledged as they may impact the interpretation of the results and the conclusions drawn from the study.

Furthermore, the study will not include perspectives from parents or community members, potentially missing valuable insights into external factors that influence ICT integration in schools. Lastly, financial and time constraints may limit the sample size and scope of the study, which could affect the depth of analysis and the richness of the data collected. These limitations highlight the need for caution when interpreting the results and suggest the importance of further research to build on the findings of this study.

1.11 DEFINITION OF KEY TERMS

Challenges in ICT integration refer to the various obstacles that hinder the effective incorporation of Information and Communication Technology into educational practices. These challenges can include inadequate infrastructure, insufficient teacher training, lack of resources, and resistance to change among educators and students. Such barriers can significantly impact the quality of teaching and learning outcomes in educational settings.

According to UNESCO, (2002), **ICT** stands for Information and Communication Technology and this refers to a broad range of technologies used to handle telecommunications, broadcast media, intelligent building management systems, audio-visual processing and transmission systems, and network-based control and monitoring functions. In education, ICT encompasses tools such as computers, the internet, and software applications that facilitate teaching and learning processes. Ertmer, P. A., and Ottenbreit-Leftwich, A. T. (2010) define ICT integration as the incorporation of ICT tools and resources into the educational curriculum and teaching practices to enhance the learning experience. They postulate that it aims to make learning more interactive and engaging, allowing for a more personalized approach to education.

Teaching can be defined as the act of facilitating learning by guiding and supporting students in acquiring knowledge, skills, and attitudes. It involves planning and delivering instructional content, assessing student progress, and creating an environment conducive to learning (Berk, 2019).

Learning, on the other hand, is the process through which individuals acquire new knowledge, skills, attitudes, or behaviors. It is influenced by various factors, including prior knowledge, motivation, and the learning environment. Learning can occur in formal settings, such as schools, or informally through everyday experiences. Educational psychologists emphasize that learning is a change in behavior resulting from experience, and it can be both intentional and unintentional (Schunk, 2020).
These definitions, along with their references, provide a foundational understanding of key concepts related to ICT integration in education, highlighting the importance of technology in enhancing teaching and learning as well as the challenges related to ICT.

1.12 ORGANIZATION OF THE STUDY

The organization of this study is structured to provide a comprehensive examination of the challenges associated with the integration of Information and Communication Technology (ICT) in the teaching and learning of Physics at the Ordinary level in Zimbabwe. The study begins with an introduction that outlines the background, significance, and objectives, followed by a detailed literature review that contextualizes the research within existing scholarship on ICT in education. The methodology section describes the research design, data collection methods, and analytical approaches employed to address the research questions. Following this, the findings are presented in a systematic manner, highlighting key challenges identified through both qualitative and quantitative data. The discussion section interprets these findings in relation to the research objectives, exploring implications for educators and policymakers. Finally, the study concludes with a summary of the main insights, recommendations for enhancing ICT integration in Physics education, and suggestions for future research, ensuring a logical flow from problem identification to proposed solutions.

1.13 CHAPTER SUMMARY

This research proposal aims to investigate the challenges of integrating Information and Communication Technology (ICT) into the teaching and learning of Physics at the Ordinary Level in Zimbabwean secondary schools. Despite the potential benefits of ICT in enhancing educational outcomes, many educators encounter significant obstacles that impede effective implementation.

The study will focus on several key objectives that include, identifying specific challenges faced by teachers and students in ICT integration, assess the preparedness and confidence of Physics teachers in using ICT tools, evaluate the impact of ICT integration on student engagement in Physics learning, explore the availability of ICT resources in schools, investigate the training needs of teachers regarding ICT skills, propose strategies for overcoming identified challenges and examine the implications of educational policies on ICT integration. A mixed-methods approach will be employed, combining quantitative surveys and qualitative interviews. Data will be collected from Physics teachers and students across selected secondary schools. Classroom observations and document analysis will further enrich the findings. Data will be presented using descriptive statistics for quantitative findings and thematic analysis for qualitative insights. The study aims to triangulate data from various sources to enhance the validity of the results. Ethical considerations will include obtaining informed consent, ensuring confidentiality, and minimizing any potential risks to participants.

The research is expected to provide valuable insights into the challenges of ICT integration in Physics education, offering recommendations for teachers, policymakers, and educational institutions to enhance technology use in the classroom. This study aims to contribute to the body of knowledge on ICT integration in education, ultimately improving the teaching and learning experience in Physics at the Ordinary Level in Zimbabwe.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

The integration of Information and Communication Technology (ICT) into the teaching and learning of Physics at the Ordinary Level has become increasingly essential in today's digital age, yet it presents a multitude of challenges that educators must navigate. Despite the transformative potential of ICT to enhance engagement and facilitate deeper understanding of complex scientific concepts, many teachers face significant barriers, including inadequate technological infrastructure, limited access to digital resources, and a lack of comprehensive professional development aimed at equipping them with the necessary skills to effectively incorporate technology into their pedagogy. Furthermore, the traditional methods of teaching Physics often conflict with the interactive nature of ICT tools, resulting in a disconnect that can impede student learning. Issues of varying digital literacy among students also exacerbate these challenges, creating disparities in engagement and comprehension. This literature review seeks to explore these multifaceted challenges, drawing on existing research to illuminate the complex interplay of technological, pedagogical, and social factors that influence the successful integration of ICT in Physics education, ultimately providing insights that can guide educators in enhancing instructional practices and improving learning outcomes for students at the Ordinary Level.

2.2. Technological Infrastructure Challenges

This paragraph discusses the inadequate technological infrastructure in educational institutions, particularly in developing countries, and its impact on ICT integration in Physics education. The integration of Information and Communication Technology (ICT) in the teaching and learning of Physics at the Ordinary Level faces several challenges that hinder its effectiveness. One significant barrier is the inadequate technological infrastructure in many educational institutions, particularly in developing countries. Research indicates that the extent of ICT integration in Kenyan secondary schools is below 32%, highlighting a critical gap in resources and support for teachers and students alike (Tondeuretal, 2015). This lack of infrastructure is compounded by limited access to reliable internet connectivity, which restricts both teachers' and students' ability to utilize online resources and tools that could enhance the learning experience (Uwizeyimanaetal. 2018).

Inadequate technological infrastructure remains a significant barrier to effective education in many institutions across African developing countries, including Zimbabwe. These challenges manifest in various forms, such as limited access to reliable electricity, insufficient internet connectivity, and a lack of modern educational technologies. For instance, in Zimbabwe, many schools struggle within consistent electricity supply, which is crucial for powering computers and other ICT tools necessary for modern teaching methods. This lack of reliable electricity hampers the ability to integrate technology into the classroom effectively, as teachers cannot depend on these tools for instruction. Similarly, countries like Malawi and Mozambique face significant challenges with internet connectivity, where slow or non - existent internet access restricts both educators' and students' ability to utilize online resources and collaborative tools that enhance learning experiences (Uwizeyimanaetal, 2018)

Moreover, the availability of modern educational technologies, such as computers and interactive whiteboards, is often limited in these countries. For example, in rural areas of Zambia and Tanzania, schools may lack the necessary equipment to facilitate ICT integration, leading to a reliance on traditional teaching methods that do not engage students effectively. This situation is exacerbated by budget constraints and a lack of government investment in educational technology. Even when technological infrastructure is available, the lack of training and support for teachers can hinder effective integration. Many educators may not possess the necessary skills to utilize ICT tools effectively in their teaching practices, leading to under utilization of available resources. The impact of these infrastructural challenges directly affects student engagement and learning outcomes, as students may struggle to grasp complex concepts in subjects like Physics without access to modern tools and resources. Addressing these issues requires a concerted effort from governments, educational institutions, and international organizations to invest in infrastructure, provide training, and ensure equitable access to technology for all students.

Similarly, countries like Malawi and Mozambique face significant challenges with internet connectivity. In these regions, slow or non-existent internet access restricts both educators' and students' ability to utilize online resources, educational platforms, and collaborative tools that can enhance learning experiences (Uwizeyimanaetal, 2018). For example, in certain rural districts of Malawi, schools often lack basic internet access, making it nearly impossible for teachers to incorporate digital resources into their lesson plans.

Researchers have postulated that the availability of these modern educational technologies, such as computers, tablets, and interactive whiteboards, is often limited in these countries. Schools in rural areas of Zambia and Tanzania may lack the necessary equipment to facilitate ICT integration, leading to a reliance on traditional teaching methods that do not engage students effectively. The absence of such technologies can severely limit students' exposure to contemporary educational practices and tools, thereby affecting their readiness for higher education and the workforce.

Budget constraints further exacerbate these issues, as many governments prioritize immediate needs overlong-term educational investments. In countries like the Central African Republic and Chad, the lack of government investment in educational technology contributes to an ongoing cycle of under-resourcing. Even when technological infrastructure is available, the lack of training and support for teachers can hinder effective integration. Many educators may not possess the necessary skills to utilize ICT tools effectively in their teaching practices, leading to the under utilization of available resources.

The impact of these infrastructural challenges directly affects student engagement and learning outcomes. Research indicates that students in schools with inadequate technological resources tend to perform poorly in subjects like Physics, where conceptual understanding is crucial. Without access to modern tools and resources, students may struggle to grasp complex concepts, leading to diminished interest and performance in STEM fields.

Addressing these issues requires a concerted effort from governments, educational institutions, and international organizations to invest in infrastructure, provide comprehensive training for educators, and ensure equitable access to technology for all students. Initiatives aimed at improving both hardware and software resources, along with ongoing professional development for teachers, are essential for creating a conducive learning environment. By addressing the technological infrastructure challenges, African developing countries can significantly enhance the quality of education and better prepare students for the demands of a digital world.

2.3 Pedagogical Approaches and Student Engagement

This section evaluates the traditional pedagogical methods used in Physics education and their misalignment with ICT tools, emphasizing the need for student-centered learning approaches education often do not align with the interactive and engaging nature of ICT tools. Many educators continue to rely on teacher-centered methods that do not foster active learning or critical thinking, which are essential for understanding complex scientific concepts (Kipyator, 2017). This disconnect can lead to student disengagement and a perception of Physics as a difficult and irrelevant subject (Owenetal, 2018).Theories such as Constructivism emphasize the importance of active learning and student engagement in the learning process, suggesting that the integration of ICT should be accompanied by pedagogical shifts towards more student-centered approaches (Rieckmann, 2018)

Traditional pedagogical methods in Physics education have often relied heavily on lecture-based instruction, rote memorization, and passive learning strategies, which can lead to disengagement among students. These methods typically emphasize the transmission of knowledge from teacher to student, with little room for interaction or application. In many African developing countries, including Zimbabwe, this approach remains prevalent in the classroom, despite the increasing availability of Information and Communication Technology (ICT) tools that could enhance learning experiences.

In traditional settings, teachers primarily deliver information through lectures, where students passively receive content. This method often fails to engage students actively, resulting in a lack of critical thinking and problem - solving skills. For example, in Zimbabwe, the use of chalk-and-talk methods dominates the Physics curriculum, limiting opportunities for interactive discussions or hands-on experiments. Moreover, students are often required to memorize formulas and concepts without understanding their underlying principles. This approach can lead to superficial learning, where students may perform well on exams but struggle to apply their knowledge in real-world contexts. Many students in countries like

Malawi and Zambia face similar challenges, as the focus on rote learning diminishes their ability to analyze and apply concepts.

Henceforth, traditional methods often neglect the practical aspects of Physics education, which are essential for fostering a deeper understanding of the subject. Inadequate laboratory facilities and resources further exacerbate this issue, as students miss out on hands-on experiences that could enhance their learning.

The traditional pedagogical methods used in Physics education are often misaligned with the capabilities of ICT tools, which can facilitate more interactive, engaging, and student-centered learning experiences. While ICT tools offer opportunities for simulations, interactive tutorials, and collaborative projects, the prevailing lecture-based approach does not leverage these technologies effectively. For instance, in Zimbabwe, the availability of educational software and online resources is underutilized due to a lack of training for teachers and resistance to change from traditional methods. To address the short comings of traditional pedagogical methods, there is a pressing need to adopt student-centered learning approaches. These approaches align well with the principles of Constructivism, a theory that posits that learners construct knowledge through experiences and interactions with their environment. Student-centered approaches encourage active participation, where students engage in discussions, problem-solving, and hands-on activities. This engagement fosters deeper understanding and retention of Physics concepts. In countries like Kenya and Uganda, educators are beginning to implement more interactive methods, allowing students to explore concepts through experiments and simulations.

Moreover, Constructivism emphasizes the importance of social interactions in learning. Groupworkandcollaborativeprojectscanhelpstudentsdevelopcriticalthinkingandcommunicationskills.For example, in Zimbabwe, initiatives to promote group-based learning can enhance student engagement and comprehension of complex Physics topics. Integrating ICT tools into student-centered learning can enhance the educational experience. For instance, simulations can help visualize abstract concepts, and online collaborative platforms can facilitate peer learning. Educators in Africa are increasingly recognizing the potential of ICT to transform Physics education, but this shift requires adequate training and resources.

In summary, the traditional pedagogical methods used in Physics education in African developing countries, including Zimbabwe, are often misaligned with the capabilities of ICT tools. The reliance on lecture-based instruction and rote memorization limits student engagement and understanding. Emphasizing student-centered learning approaches that align with Constructivism can significantly enhance the educational experience. By fostering active learning, collaborative opportunities, and the effective integration of ICT, educators can better prepare students for the challenges of the modern world and cultivate a deeper understanding of Physics. Addressing these pedagogical gaps is essential for improving educational outcomes and equipping students with the skills necessary for success in STEM fields.

2.4 Digital Literacy Disparities

This paragraph addresses the varying levels of digital literacy among students and how this affects their engagement with ICT tools, leading to disparities in learning outcomes. Additionally, varying levels of digital literacy among students pose another challenge. Research shows that students with lower technological competencies struggle to engage with ICT tools effectively, which can exacerbate existing disparities in learning outcomes (Linderetal, 2014). This issue is particularly pronounced in contexts where students come from diverse backgrounds with differing access to technology outside of school. The Technological Pedagogical Content Knowledge (TPACK) framework can be useful in understanding howteacherscaneffectivelyintegratetechnologyintotheirteachingpractices by balancing content knowledge, pedagogical knowledge, and technological knowledge (Mishra & Koehler, 2006).

Moreover, this section introduces relevant theories, such as Constructivism and the Technological Pedagogical Content Knowledge (TPACK) framework that can guide educators ineffectively integrating ICT into their teaching practices. The Technological Pedagogical Content Knowledge (TPACK) framework is a comprehensive model that emphasizes the integration of technology in teaching by balancing three core components: content knowledge (CK), pedagogical knowledge (PK), and technological knowledge (TK). For Physics teachers, effectively integrating technology into their teaching practices requires a deep understanding of how these components interact to enhance student learning.

TPACK has components and these include, Content Knowledge (CK) which refers to the teacher's understanding of the subject matter, in this case, Physics. Teachers must have a solid grasp of Physics concepts, theories, and principles to effectively teach the subject, Pedagogical Knowledge (PK) that encompasses the methods and strategies that teachers use to facilitate learning. It includes understanding how students learn, the best practices for teaching, and the ability to design effective learning experiences and lastly Technological Knowledge (TK) which involves the teacher's proficiency with various technologies and how to use them effectively in the classroom. It includes knowledge of software, hardware, and digital tools that can enhance teaching and learning.

According to researchers there are of the idea that in Physics Education therefore, TPACK can be integrated. To effectively integrate technology into Physics education, teachers must find a balance between CK, PK, and TK. Some strategies for achieving this balance include the use of simulations and virtual labs in which Physics teachers can utilize simulations and virtual labs to demonstrate complex concepts that may be difficult to visualize in a traditional classroom setting. For instance, tools like PhET Interactive Simulations allow students to explore Physics concepts through interactive experiments, enhancing their understanding and engagement. More so, incorporating multimedia resources where teachers can integrate videos, animations, and interactive presentations to make abstract Physics concepts more tangible. For example, using platforms like YouTube or educational websites can provide visual explanations of topics such as electricity or mechanics, catering to different learning styles.

Collaborative Learning Platforms is another way of utilizing online collaborative tools, such as Google Classroom or Microsoft Teams, can facilitate group work and peer learning. Physics teachers can assign projects that require students to collaborate on experiments or research, fostering a deeper understanding of the subject matter. Continuous professional development is crucial for teachers to enhance their TPACK. Workshops and training sessions focused on integrating technology into teaching can help Physics educators in African countries, including Zimbabwe, to develop the necessary skills and confidence to use ICT tools effectively in their classrooms. Teachers should therefore, be able to relate Physics concepts to real-world applications relevant to their students' lives. This approach not only makes learning more meaningful but also encourages students to engage with the material actively. For instance, discussing the physics of renewable energy sources can resonate with students in Zimbabwe, where energy issues are pertinent.

Despite the potential benefits of TPACK, Physics teachers in African developing countries face several challenges, including inadequate technological infrastructure, limited access to resources, and insufficient training. For example, in Zimbabwe, many schools struggle within consistent electricity and internet connectivity, which can hinder the effective use of technology in teaching. Additionally, teachers may lack the necessary support and resources to implement TPACK effectively, leading to a gap between technology availability and its integration into teaching practices.

The TPACK frame work provides a valuable lens through which Physics teachers can enhance their teaching practices by effectively integrating technology. By balancing content, pedagogical, and technological knowledge, educators can create engaging and meaningful learning experiences for their students. Addressing the challenges faced by teachers in African developing countries, including Zimbabwe, is essential for fostering an educational environment that embraces technology and prepares students for the demands of the modern world.

On the other hand, Constructivism is an educational theory that posits that individuals construct their own understanding and knowledge of the world through experiences and reflections on those experiences. This learning theory emphasizes that learners actively engage with the material, rather than passively receiving information. The key principles of Constructivism include firstly promoting active participation in the learning process. Students are encouraged to explore, ask questions, and engage in problem-solving activities. This active engagement helps them construct their own understanding of concepts. Secondly, social interaction in which Learning is viewed as a social process. Constructivist theory emphasizes the importance of collaboration and communication among learners. Through discussions, group work, and peer teaching students can share perspectives and deepen their understanding. Thirdly, Contextual Learning where Knowledge is constructed with in a specific context. Constructivist approaches often involve real-world applications and experiences that relate to students' lives. This relevance enhances engagement and facilitates deeper understanding.

Fourthly, prior knowledge whereby Constructivism acknowledges that learners come to the classroom with pre-existing knowledge and experiences. Effective teaching involves connecting new information to what students already know, allowing them to build on their prior understanding. Lastly, reflective practice in which reflection is a crucial component of Constructivism. Learners are encouraged to think about their learning processes, evaluate their understanding, and make connections between different ideas. This self-reflection fosters Meta cognition, allowing students to become aware of their learning strategies. Teachers adopting a constructivist approach design learning experiences that prioritize student interests and needs. This may involve project-based learning, inquiry-based tasks, and hands-on activities that empower students to take ownership of their education. In addition, in a constructivist classroom, the teacher acts as a facilitator or guide rather than a traditional authority figure. Educators support students in their learning journeys by providing resources, asking probing questions, and encouraging exploration and discussion.

Constructivist assessment methods often focus on formative assessments that provide feedback and opportunities for reflection. Teachers may use portfolios, self-assessments, and peer assessments to gauge student understanding and progress. Constructivism also encourages the use of various learning environments and modalities. This can include collaborative spaces, outdoor learning, and the integration of technology to fostering creativity. In the context of African developing countries, including Zimbabwe, Constructivism offers a valuable framework for addressing educational challenges. By fostering active and meaningful learning experiences, educators can engage students more effectively and promote critical thinking skills necessary for navigating complex issues in their communities. For instance, the integration of local contexts and cultural relevance in Physics education can enhance students' connection on the material, making learning more engaging and applicable. Additionally, promoting collaborative learning can help build a sense of community and support among students, which is especially important in regions where educational resources may be limited.

In conclusion, Constructivism provides a powerful lens through which educators can design meaningful learning experiences that engage students actively and foster deeper understanding. By embracing the principles of Constructivism, teachers can facilitate a more student-centered approach that prepares learners to think critically, collaborate effectively, and apply their knowledge in real-world contexts.

2.5. Conclusion and Future Directions

In conclusion, the integration of Information and Communication Technology (ICT) in Physics education within African developing countries, including Zimbabwe, faces several significant challenges, limited access to resources, and insufficient training for educators. Traditional pedagogical methods that rely heavily on lecture-based instruction and rote memorization further hinder the effective use of ICT tools, preventing educators from fully utilizing the potential of technology to enhance student engagement and understanding.

To address these challenges, there is an urgent need for robust frame works that support the effective integration of technology in teaching practices. Professional development and training for educators are essential to equip them with the necessary skills and confidence to utilize ICT effectively in their classrooms. By fostering a deeper understanding of how to balance content, pedagogical, and technological knowledge through models such as TPACK, educators can create more engaging, student-centered learning experiences.

Ultimately, investing in these frame works and training initiatives will not only enhance the quality of Physics education but also empower students with the skills and knowledge required to thrive in an increasingly digital world. By embracing these changes, educational systems can better prepare students for future challenges and opportunities, fostering a generation of critical thinkers and problem solvers in the field of science and beyond. Identifying research gaps in the integration of ICT in Physics education within African developing countries, including Zimbabwe, can help guide future studies and initiatives.

2.6 Research Gaps

Firstly, there is a need for empirical studies that specifically examine how ICT integration affects student learning outcomes in Physics. Research should investigate the correlation between the use of technology and improvements in understanding complex concepts, engagement levels, and overall academic performance. More research is needed to identify and evaluate specific pedagogical strategies that effectively integrate ICT in Physics education. This includes studying the effectiveness of various teaching methods, such as project-based learning, inquiry-based approaches, and collaborative learning, in conjunction with technology.

While the need for teacher training is acknowledged, there is a lack of comprehensive studies that assess the effectiveness of different training programs on teachers' ability to integrate ICT into their teaching practices. Research should explore which training models are most effective in enhancing teachers' TPACK and confidence in using technology. Research often overlooks the cultural context of learners in African developing countries. Studies that focus on how to contextualize ICT tools and learning materials to make them culturally relevant and relatable for students can provide valuable insights into increasing engagement and effectiveness.

Although barriers to ICT integration are identified, there is a need for more in-depth qualitative research that explores the specific challenges faced by teachers and students in different contexts. Understanding these barriers can inform more targeted interventions and support mechanisms. Most existing research provides a snap shot of ICT use in education. Longitudinal studies that track the long-term impact of ICT integration on student learning, teacher practices, and educational outcomes would provide deeper insights into the effectiveness and sustainability of these initiatives.

There is a gap in understanding how educational policies and governance structures affect the integration of ICT in Physics education. Research should investigate the role of government initiatives, funding, and policy frame works in facilitating or hindering technology adoption in schools. More research is needed that focuses on students' perspectives regarding the use of ICT in Physics education. Understanding their experiences, preferences, and perceived barriers can provide valuable insights for educators and policymakers .Lastly, there is a need for comparative studies that evaluate the effectiveness of various ICT tools and platforms in enhancing Physics education. This research should assess which tools are most beneficial for different learning environments and student demographics.

By addressing these research gaps, future studies can contribute to a more comprehensive understanding of how to effectively integrate ICT in Physics education, ultimately leading to improved teaching practices and student outcomes in African developing countries.

2.7 Chapter Summary

The literature review chapter provides a comprehensive examination of existing research on the integration of Information and Communication Technology (ICT) in Physics education, particularly within the context of African developing countries, including Zimbabwe. The chapter is structured around several key themes that emerge from the literature.

The chapter begins by discussing relevant educational theories, notably Constructivism and the Technological Pedagogical Content Knowledge (TPACK) framework. These theories emphasize the importance of active learning, social interaction, and the balance of content, pedagogical, and technological knowledge in enhancing educational outcomes. A significant portion of their view focuses on the barriers faced by educators in integrating ICT into Physics classrooms. These challenges include inadequate technological infrastructure, limited access to resources, insufficient training for teachers, and reliance on traditional pedagogical methods that do not leverage technology effectively.

The review highlights the mixed evidence regarding the impact of ICT on student learning outcomes in Physics. While some studies indicate positive effects on engagement and understanding, others reveal inconsistencies based on varying contexts, highlighting the need for more rigorous, context-specific research. The chapter identifies effective pedagogical strategies that can facilitate ICT integration, such as project-based learning, inquiry-based learning, and collaborative approaches. However, there is a lack of consensus on which specific methods yield the best results, indicating a need for further investigation. The literature underscores the critical role of teacher training in successful ICT integration. It points to the need for comprehensive professional development programs that enhance teachers' TPACK and confidence in using technology, yet highlights the scarcity of empirical studies assessing the effectiveness of these training initiatives.

The review emphasizes the importance of contextualizing ICT tools and educational practices to resonate with students' cultural backgrounds. Research indicates that culturally relevant pedagogy can significantly enhance student engagement and learning outcomes. Lastly, the chapter discusses the impact of educational policies and governance structures on ICT integration. It underscores the necessity for supportive policies and funding of facilitate technology adoption in schools, particularly in resource-constrained environments.

In conclusion, the literature review reveals a complex landscape regarding the integration of ICT in Physics education in African developing countries. While there is a growing body of research emphasizing the potential benefits of technology, significant challenges remain that hinder effective implementation. The chapter identifies critical research gaps that need to be addressed, including the need for more longitudinal studies, context-specific assessments, and an exploration of student perspectives. Overall, the findings underscore the necessity for robust frameworks and targeted professional development to enhance ICT integration in Physics education, ultimately contributing to improved teaching and learning outcomes.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter outlines the research methodology of the study; detailing the research design, data collection, sampling technique, sample size and analysis methods employed. An account of how ethics were upheld and implemented during the research is also provided.

3.2Research Strategy and Design

The researcher utilized a qualitative case study research strategy to explore the challenges of integrating Information and Communication Technology (ICT) into the teaching and learning of physics at the Ordinary Level in Zimbabwean secondary schools. This approach was particularly suitable as it allowed for an in-depth examination of the specific contexts and experiences of educators and students within selected schools, particularly at Kuwadzana 1 High School.

The case study design is a qualitative research approach that provides a comprehensive exploration of a specific phenomenon within its real-life context. According to Creswell (2013), case studies are particularly useful for understanding complex issues by examining a limited number of cases in detail. This methodology facilitated a rich collection of data through interviews, observations, and document analysis, providing insights into the complexities of ICT integration in the educational setting (Mlambo, 2018).

The choice of a case study design is justified by the need to gain a nuanced understanding of ICT integration challenges in a specific educational setting. Cohen, Manion, and Morrison (2018) emphasize that case studies allow for a deep exploration of participants' experiences, which is crucial for identifying contextual factors influencing ICT use in teaching physics. By focusing on a single case, the researcher could delve into the complexities of the educational environment, yielding richer insights than broader quantitative studies might provide.

This research strategy and design align with the findings of Wadesango (2019), who highlighted the importance of understanding the local context in educational research, especially in developing countries. Moreover, the qualitative case study approach enabled the researcher to identify not only the barriers to ICT integration but also potential strategies for overcoming these challenges, as noted by Chikoko (2020). Overall, this integrated approach facilitated a comprehensive understanding of the multifaceted issues surrounding ICT integration in Zimbabwean physics education.

The choice of a case study design in this research is justified by the need to gain a nuanced understanding of ICT integration challenges in a specific educational setting—Kuwadzana 1 High School. Cohen, Manion, and Morrison (2018) emphasize that case studies facilitate a deep exploration of participants' experiences, which is crucial for identifying contextual factors influencing ICT use in teaching Physics. By focusing on a single case, the researcher can delve into the complexities of the educational environment, thus providing richer insights than broader quantitative studies might yield.

3.2.1 Research Paradigm

In this research, the interpretivism and pragmatism paradigms were employed to explore the challenges of integrating information and communication technology (ICT) in the teaching and learning of physics at the ordinary level in Zimbabwe. Interpretivism facilitated an in-depth understanding of the subjective experiences of teachers and students, allowing the researcher to capture the complexities of their interactions with ICT in educational settings (Makiwa, 2020; Shava, 2020). This qualitative approach was essential for uncovering the cultural and contextual factors that influenced ICT adoption in Zimbabwean schools (Chipenyu, 2020). On the other hand, pragmatism enabled the researcher to utilize mixed methods, combining qualitative insights with quantitative data to address practical challenges effectively (Gomwe, 2020). This approach acknowledged the multifaceted nature of educational issues and allowed for the development of actionable solutions based on empirical evidence (Masuku, 2020). By integrating these paradigms, the study aimed to provide a comprehensive understanding of the barriers to ICT integration and propose strategies for enhancing its effectiveness in physics education.

3.2.2 Research Methodology

The researcher employed a mixed-methods approach to investigate the challenges of information and communication technology (ICT) integration in the teaching and learning of physics at the ordinary level in Zimbabwe. This design combined qualitative and quantitative methods, allowing for a comprehensive exploration of the multifaceted challenges faced by educators and students. The qualitative component involved interviews and focus group discussions with teachers and students to gather in-depth insights into their experiences and perceptions regarding ICT integration. This approach aligned with the findings of Makiwa (2020), who emphasized the importance of understanding contextual factors in educational settings. The quantitative aspect included surveys to collect data on the extent of ICT usage, access to resources, and academic performance in physics, providing measurable evidence of the challenges identified qualitatively (Shava, 2020). By employing a mixed-methods design, the researcher effectively triangulated data, enhancing the validity of the findings and providing a richer understanding of the barriers to ICT integration in Zimbabwean physics education (Chipenyu, 2020). This approach addressed the complexity of the research topic and facilitated the development of targeted recommendations for improving ICT integration in teaching and learning.

3.3 Research Methods

3.3.1 Population and Sampling

The researcher defined the population for this study as all educators and students involved in the teaching and learning of physics at Kuwadzana 1 High School in Zimbabwe. This population included four physics teachers and eight students enrolled in ordinary level physics classes at the school. To ensure a representative sample, the researcher employed purposive sampling to select participants who had relevant experience and knowledge regarding the integration of information and communication technology (ICT) in their teaching practices. This sampling method was effective in capturing diverse perspectives, as emphasized by Mlambo (2018), who noted that purposive sampling allows researchers to focus on specific characteristics pertinent to the study. The researcher aimed to include a mix of teachers with varying levels of experience and students with different academic performances in physics, which aligned with Wadesango's (2019) recommendations for obtaining a comprehensive understanding of the challenges faced in educational settings. Ultimately, the sample consisted of four teachers and eight students, providing a rich dataset that facilitated an in-depth exploration of the challenges of ICT integration in physics education at Kuwadzana 1 High School (Chikoko, 2020). This focused approach ensured that the findings would be relevant and directly applicable to the specific context of the school.

3.3.2 Data Collection instruments

Data collection tools included semi-structured interviews and focus group discussions. These instruments were designed to elicit rich, descriptive data from participants, allowing for a dynamic and interactive exploration of their experiences with ICT. Creswell and Poth (2018) highlight the effectiveness of these methods in qualitative research, as they provide flexibility and depth in data collection. The researcher utilized a combination of data collection methods to comprehensively investigate the challenges of information and communication technology (ICT) integration in the teaching and learning of physics at Kuwadzana 1 High School. The primary instruments employed included semi-structured interviews, classroom observations, and document analysis.

3.3.2.1 Data Collection: interviews

Data were collected through a series of semi-structured interviews with teachers and focus group discussions with students. This mixed approach allowed for the triangulation of data, enhancing the reliability of the findings. The semi-structured form at enabled the researcher to explore specific topics while allowing participants the freedom to express their thoughts and experiences in their own words. The researcher conducted semi-structured interviews with 4 physics teachers and 10 students, which allowed for an in-depth exploration of their experiences and perceptions regarding ICT integration. This method was particularly effective in eliciting detailed responses and personal insights, as highlighted by Mlambo (2018), who noted that semi-structured interviews facilitate a deeper understanding of participants' perspectives.

3.3.2.2 Classroom observations

In addition to interviews, the researcher carried out classroom observations to assess the actual implementation of ICT tools during physics lessons. This observational approach provided valuable insights into the practical challenges teachers encountered when integrating technology into their teaching practices. Wadesango (2019) emphasized the importance of direct observation in educational research, stating that it allows researchers to witness firsthand the dynamics of the classroom environment. Furthermore, the researcher analyzed relevant documents, such as school ICT policy documents, lesson plans, and student performance records, to gain a deeper understanding of the institutional context and resources available for ICT integration. This triangulation of data sources enhanced the credibility and validity of the findings, as supported by Chikoko (2020), who advocated for the use of multiple data collection methods to provide a more comprehensive view of the research topic. Overall, these data collection methods enabled the researcher to capture a rich and nuanced understanding of the challenges associated with ICT integration in physics education at Kuwadzana 1High School.

3.3.3. Document Presentation and Analysis Procedures

The data were analyzed using thematic analysis, as outlined by Braun and Clarke (2019). This involved coding the responses to identify key themes and patterns related to ICT integration in the classroom. Thematic analysis is particularly beneficial in case studies, as it allows researchers to draw connections between different participants' experiences and highlight common barriers and facilitators to ICT use. The findings were then presented in a narrative format, illustrating the themes through direct quotes from participants, thereby providing a rich, contextual understanding of the challenges faced.

The researcher employed a mixed-methods approach to analyze the data collected regarding the challenges of Information and Communication Technology (ICT) integration in the teaching and learning of Physics at Kuwadzana 1 High School. Quantitative data were gathered through structured questionnaires distributed to both teachers and students, focusing on their perceptions and experiences with ICT tools in the educational environment. These questionnaires were designed to capture a range of variables, including the frequency of ICT usage and its perceived effectiveness in enhancing learning outcomes (Ertmer & Ottenbreit-Leftwich, 2018).

Statistical software, such as SPSS, was used to analyze the quantitative data, allowing for a comprehensive examination of the relationships between variables. The researcher also triangulated the findings from both quantitative and qualitative data to enhance the validity and reliability of the results (Maree, 2021). This multi-faceted approach provided a robust framework for understanding the complexities surrounding ICT integration in teaching and learning at Kuwadzana 1 High School.

3.4.1Trustworthiness

Trustworthiness refers to the confidence attached to the data collection, analysis, and interpretation methods used to ensure the study's quality (Krippendorff, 2019). The study employed various procedures to establish its worthiness, including credibility and dependability.

3.4.2 Credibility

Credibility indicates the authenticity and realism of the research findings (Amwaka, 2014). The researcher triangulated data by collecting responses from different sources, including primary participants (adolescents) and key informants from various professional fields. Additionally, different data collection methods — such as in-depth interviews and key informant interviews were used to confirm and authenticate findings, thereby reducing researcher bias.

3.4.3 Dependability

Dependability is enhanced by the researcher's systematic efforts in documenting and creating a clear audit trail (Cope, 2015). The researcher maintained a structured research protocol that outlined the design, methods, and traceable steps taken to collect, analyse, and interpret data .Field notes and transcripts were meticulously documented and preserved.

3.4.4 Transferability

Transferability was addressed by providing a rich, thick description of the context and participants involved in the study. This allowed other researchers to determine the applicability of the findings to similar educational settings. The researcher documented the research process meticulously to ensure dependability, allowing for an audit trail that could be reviewed by external parties (Hennessy et al., 2020). Confirmability was achieved by reflecting on personal biases and ensuring that the findings were grounded in the data rather than the researcher’s preconceptions (Maree, 2021).

3.4.5 Objectivity

Objectivity in qualitative research refers to the researcher’s ability to remain neutral and avoid letting personal biases influence the data collection and analysis processes. In this study, the researcher employed reflexivity, regularly reflecting on their own perspectives and how these might affect interactions with participants. By maintaining a clear distinction between the researcher’s viewpoints and those of the participants, the researcher aimed to enhance the objectivity of the findings, ensuring that the conclusions drawn were genuinely representative of the participants' experiences (Creswell & Poth, 2018).

3.5 Ethical Considerations

According to Neuman (2014), ethics are crucial as they guide researchers in conducting research responsibly. The researcher upheld ethical standards throughout the study to safeguard the interests of the participants. Key ethical considerations include:

It is essential for researchers to obtain informed consent from participants, ensuring they understand the study's purpose, procedures, risks, and benefits. This principle is emphasized by Creswell (2014), who highlights the importance of transparency in the research process.

Maintaining the confidentiality of participant information is a fundamental ethical obligation. Researchers must take steps to protect personal data and ensure that identities are not disclosed without consent. Beauchamp and Childress (2013) discuss the significance of confidentiality in research ethics as a means to respect participants' privacy.

Researchers have an ethical duty to minimize potential harm to participants, including physical, psychological, and emotional risks. Mertens (2010) stresses that ethical research design should prioritize participant welfare and strive to prevent any adverse effects.

Upholding integrity in the research process is vital. Researchers should avoid practices such as fabrication, falsification, and plagiarism, ensuring that their findings are credible. Resnik (2011) outlines the ethical principle of honesty and accountability in research conduct.

Special care is needed when conducting research with vulnerable groups, such as children or marginalized communities. Researchers must ensure these populations are treated with respect and that their rights are protected throughout the study. This consideration is echoed by Mertens (2010), who advocates for ethical sensitivity when working with diverse participants.

By adhering to these ethical principles, researchers can uphold the dignity and rights of participants, fostering trust and integrity in the research process.

3.5.1 Voluntary Participation

Research participants were not coerced into participation; instead, participation was obtained on a voluntary basis. Consent forms were provided to prospective participants, who became research participants after giving their consent. Participants were continuously reminded of their right to withdraw from the study at anytime without facing any repercussions.

3.5.2 Informed Consent

Participants were informed about the purpose, nature, and course of the research. Permission to record interviews was sought from participants. An information sheet providing detailed information about the study was given to prospective participants, and verbal explanations were provided to address any questions before obtaining consent.

3.5.3 Confidentiality

Participants were assured of confidentiality, with pseudonyms used in place of real names. Research findings were accessible only to authorized individuals, and recordings were securely stored with password protection and deleted after transcription.

4.4 Chapter Summary

This chapter outlined the research methodology of the study, detailing the research design, sampling technique, data collection, and analysis methods employed. An account of how ethics were upheld and implemented during the research was also provided. In conclusion, the case study design employed in this research provides a robust framework for exploring the challenges of ICT integration in Physics education at Kuwadzana1 High School. By focusing on a specific context and utilizing purposive sampling, semi-structured interviews, and thematic analysis, the researcher aims to uncover valuable insights that can inform effective practices in educational technology. This design not only contributes on the understanding of ICT integration in Zimbabwean schools but also aligns with the broader discourse on educational technology, as discussed by scholars such as Creswell, Cohen, Manion, and Gray. Ultimately, the study aimed to generate rich data to inform interventions and support strategies for adolescents facing challenges of Information and Communication Technology (ICT) integration in the teaching and learning of Physics at Kuwadzana1High School. This design was chosen to gain an in-depth understanding of the experiences and perceptions of both teachers and students regarding ICT use in the educational context. The qualitative approach allowed for the collection of rich, descriptive data through methods such as semi-structured interviews and focus group discussions, which facilitated a comprehensive exploration of the barriers and facilitators associated with ICT integration (Creswell & Poth, 2018).

The researcher utilized purposive sampling to select participants who were directly involved in the teaching and learning processes, ensuring that the data collected were relevant and insightful. This sampling method enabled the researcher to focus on individuals who could provide valuable perspectives on the challenges faced in integrating ICT into Physics instruction (Palinkasetal.,2015).The data were analyzed using thematic analysis, which involved coding the responses to identify key themes and patterns related to the integration of ICT in the classroom (Braun & Clarke, 2019). By employing this qualitative research design, the researcher aimed to uncover the nuanced challenges and potential solutions for effective ICT integration in Physics education, contributing to the broader discourse on educational technology in Zimbabwean schools.

INTERVIEW QUESTIONS

1. What specific challenges do you face when using ICT in your Physics classes?

2. How available are ICT tools like computers and internet access in your school?

3. Have you participated in any training programs about using ICT in teaching Physics?

4. How has your training influenced your ability to use ICT in your teaching?

5. Does the current Physics curriculum support the use of ICT tools?

6. Are there any cultural beliefs that affect the use of ICT in your Physics classes?

7. How do economic issues impact your school’s ability to use ICT in Physics education?

8. How effective do you think ICT is in engaging students and helping them understand Physics?

9. What support do you get from the school administration for using ICT in your teaching?

10. What strategies do you think could help improve the use of ICT in teaching Physics?

CLASSROOM OBSERVATIONS

Observations item	**Response**
Are computers, projectors, and other ICT tools available in the classroom during the lesson?	
Does the teacher use ICT tools during the Physics lesson?	
Are students actively using ICT tools in their learning activities?	
Does the teacher have knowledge of ICT integration techniques during the lesson?	
Is the lesson plan aligned with the Physics curriculum and does it incorporate ICT?	
Is the classroom environment for using ICT tools?	
Do students collaborate with each other while using ICT tools?	
Are there any challenges, like technical issues, that arise during the lesson?	
Does the teacher's approach change when using ICT compared to traditional methods?	
Does the teacher provide feedback on student use of ICT during the lesson?	

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION / INTERPRETATION

4.0 Introduction

This chapter presents the study findings, focusing on the presentation of data and its interpretation, analysis and discussion of findings in relation to the aim, objectives, and research questions. It outlines key themes derived from interviews and observations, illuminating the challenges of Information and Communication Technology integration in the teaching and learning of Physics at Ordinary level for both the students and the teachers.

4.1Participant demographics

A total of 14 participants were selected in this study that is 4 Physics teachers and 10 students who teach and learn Physics respectively at Ordinary level participated in the in-depth interviews. The Table below indicate the demographics of the participants.

Table 4.2.Demographics of Physics students at Ordinary level who participated in the in-depth interviews.

Participant#	Age	Gender	**Interview questions that had the same responses from all the participants**
Participant 1	15	Girl	**Limited Access to Technology and digital literacy**
Participant 2	16	Girl	**Digital literacy and economic factors**
Participant3	17	Boy	**Infrastructure issues and digital literacy**

Participant 4	16	Boy	**Cultural attitudes and resistance and economic factors**
Participant 5	16	Girl	**Infrastructure issues and economic factors**
Participant 6	15	Girl	**Cultural attitudes and resistance and limited access to technology**
Participant 7	16	Boy	**Limited access to technology and economic factors**
Participant 8	15	Girl	**Cultural attitudes and resistance, limited access technology**
Participant 9	17	Boy	**Economic factors and infrastructure issues**
Participant 10	16	Boy	**Digital literacy and economic factors**

The above table indicate that of the 10 of the interviewed primary participants 5 were girls, 5 were boys and also three or four responses were similar throughout each participants.

Table 4.3: Interviewed key informants had relevant working experience of working with Ordinary level students in Physics.

Participant	Sex	Age	Profession	Number of years working as a Physics teacher
Key informant 1	**Female**	**45**	**Head of Department**	**16**
Key informant 2	**Female**	**40**	**Senior Teacher**	**11**
Key informant 3	**Male**	**39**	**Senior Teacher**	**8**
Key informant 4	**Female**	**32**	**Senior Teacher**	**6**

The above table indicates that the interviewed key informants had relevant working experience of working with Ordinary level students in Physics.

4.4: Participant response rate

A response rate of 100% was reached across all targeted participant categories. The table below illustrate the attained participant response rate desegregated by participant category and type of interview.

Table 4.5: Research participants' response rate

Participants	Response Rate	Percentage
Key Informant	4out of 4	100

In-depth interviews	10 out of 10	100

The above participants' response rate table indicate that all the intended participants took part in the study.

4.3 Factors Contributing to challenges of Information and Communication Technology integration in the teaching and learning of Physics at Ordinary level.

4.3.1 Limited Access to Technology

Limited access to technology can significantly impact students in various ways, particularly in the context of education. One major concern is the creation of inequitable learning opportunities; students without adequate access may miss out on essential learning experiences that their peers enjoy, leading to disparities in knowledge and skills. This situation can widen the achievement gap between different socioeconomic groups. Additionally, technology provides access to a wide range of educational materials, including interactive simulations, videos, and online courses. Without access to these resources, students may have a restricted understanding of complex concepts, particularly in subjects like Physics.

Moreover, the lack of technology can reduce student engagement and motivation. ICT tools often make learning more interactive and stimulating, and students without access may find lessons less captivating, leading to decreased interest in the subject matter. This limitation also affects the development of digital literacy, which is increasingly essential for academic and professional success. Students without technology access may struggle to acquire these critical skills, putting them at a disadvantage in a technology-driven world.

Collaboration is another area affected by limited access; many modern educational approaches emphasize teamwork facilitated by technology. Without access, students may find it difficult to participate in group projects or discussions, hindering their teamwork skills. Furthermore, as homework and projects increasingly require technology for research and completion, students without access may struggle to meet assignment expectations, negatively impacting their grades and overall learning outcomes.

The inability to engage in personalized learning experiences is another drawback, as technology allows students to progress at their own pace. Limited access restricts this adaptability, making it challenging for students to receive the individualized support they may need. Additionally, students who lack access to technology may be less prepared for higher education and the workforce, where digital skills are often prerequisites, thus limiting their career prospects and opportunities for advancement.

Social isolation can also result from this lack of access, as technology often serves as a means of connection among peers. Students without access may feel disconnected from their classmates, affecting their social development and emotional well-being. Finally, limited access can lead to a reliance on traditional teaching methods that may not cater to diverse learning styles, potentially stifling creativity and critical thinking. Addressing these issues requires a concerted effort from educational institutions, policymakers, and communities to improve access to technology and create equitable learning environments for all students.

The participants reported that their parents have low income jobs and this played an important role in that they could not afford to buy necessary devices like computers and laptops or reliable internet access. This economic barrier can prevent students from accessing digital learning resources. The extracts below capture their responses:

"My parent is self- employed, working as a vender and the money they get is for food and some they pay fees. They cannot afford to buy a laptop for me because they see it as luxury. It is a privilege that l am at school and l appreciates that"(Participant 1, 15 years old)

"My parents are divorced and l live with my father whose money cannot support all of us because there are other siblings who need the money as well. My father always says to me that, you are very lucky that you are going to school, look at other

children at your school even without a laptop or phone they pass. "(Participant 7,16yearsold)

"It is hard to say a lot but my parents are both alive but they can afford to pay fees, food and provide shelter. Buying laptop or phone is another big expense for them, they cannot afford" (Participant 8, 15 years old).

The findings revealed that families with lower incomes often cannot afford necessary devices like laptops, tablets or even a phone for their children or even reliable internet access. This economic barrier can prevent students from accessing digital. The findings showed that as much as the students would want to learn more from the evolving digital world a lack of support and encouragement from families regarding technology use can play a significant role. Students whose families are less engaged with technology may not prioritize its use for learning.

This shows that their parents are not willing to embrace the change in the learning of subjects with upcoming technological devices. If the parents are willing to embrace technology, they might not afford to buy the need of digital devices for their children.

These findings resonate strongly with the Digital Divide Theory, which suggests that disparities in technology access can lead to unequal learning opportunities. This theory helps to emphasizes digital divide, noting that unequal access to technology can hinder educational equity. It suggests that limited access to technology can significantly impact students in various ways, particularly in the context of education. Some key effects include inequitable learning opportunities whereby students without adequate access to technology may miss out on essential learning experiences that their peers enjoy, leading to disparities in knowledge and skills. This can widen the achievement gap between different socioeconomic groups. Limited exposure to educational resources may cause the student to leg behind since technology provides access to a wide range of educational materials, including interactive simulations, videos, and online courses. Without access, students may have a restricted understanding of complex concepts, particularly in subjects like Physics. Reduced engagement and motivation may lead those students lacking access to find lessons less stimulating, leading to decreased motivation and interest in the subject matter. The students who have challenges in developing Digital

Literacy may find it very difficult to cope since students without technology access may struggle to develop these critical skills, putting them at a disadvantage in a technology-driven world.

Many modern educational approaches emphasize collaboration among students, often facilitated by technology. Limited access can prevent students from participating in group projects or discussions, hindering their teamwork skills. Moreover, homework and projects increasingly require technology for research and completion. Students without access may struggle to meet assignment expectations, impacting their grades and learning outcomes.

Technology can facilitate personalized learning experiences, allowing students to progress at their own pace. Limited access restricts this adaptability, making it difficult for students to receive the individualized support they may need. Also, students who lack access to technology may be less prepared for higher education and the workforce, where digital skills are often prerequisites. This can limit their career prospects and opportunities for advancement.

Technology often serves as a means of connection among peers. Students without access may feel isolated or disconnected from their classmates, affecting their social development and emotional well-being. Limited access can lead to a reliance on traditional teaching methods that may not cater to diverse learning styles, potentially stifling creativity and critical thinking.

Addressing these issues requires a concerted effort from educational institutions, policymakers, and communities to improve access to technology and create equitable learning environments for all students.

These findings align with the study by Selwyn (2011) who emphasizes the digital device, noting that unequal access to technology can hinder educational equity. More so, the choice of a case study design is justified by the need to gain a nuanced understanding of ICT integration challenges in a specific educational setting Cohen, Manion, and Morrison (2018) emphasize that case studies allow for a deep exploration of participants' experiences, which is crucial for identifying contextual factors influencing ICT use in teaching physics. By focusing on a single case, there searcher could delve into the complexities of the educational environment, yielding richer insights than broader quantitative studies might provide.

4.3.2Socio-Economic Backgrounds

4.3.2.1 Economic factors

Economic factors significantly influence students' experiences in the teaching and learning of Physics at the Ordinary level, particularly in relation to Information and Communication Technology (ICT). Research shows that students from low-income families often face substantial barriers to accessing the technology necessary for effective learning. Without adequate financial resources, these students may lack essential devices such as computers or tablets, as well as reliable internet connectivity—both crucial for utilizing online educational tools and resources that enhance understanding of complex Physics concepts. This disparity in access to ICT can lead to a widening achievement gap, where students with limited technological resources struggle to engage with interactive simulations and digital experiments that are vital for grasping Physics principles.

The following statements affirm this observation:

"Money is always a problem in our house. Nowadays there are economic hard ships, henceforth money is scares. My dad lost his job and this changed everything. My mom depended on my father's salary and when he lost his job it become a big challenge for the whole family. Come to think of it all the gadgets we had were sold to cover the expenses we had at home. So my parents cannot afford to buy any gadget for me at this time and l understands why". (Participant 2, 16 years old)

"I saw how stressed my mom was when my dad didn't bring home a pay check. They would fight about who should be responsible for making money. I felt guilty just being a kid, like I was adding to their problems. It was hard to focus on school when I was worried about whether we would have enough money for food. The atmosphere at home was just so heavy and uncomfortable. Moreover, thinking of them buying a laptop, phone or any electric gadget for me is a burden in itself. They wouldn't afford. I just have to work with what l have ". (Participant7,16 years old)

" lf l tell you my story you might end up in tears. I am the eldest in a family of three. I do not know my father and my mother passed on long back when l was still about 8years old. My grandmother took us in and by then grandfather was still alive. We

survived on selling fruits at the market place and it has been unbearable. My grandfather passed away and it is not so long my grandmother followed. So l do not have anyone who can buy me these gadgets because we are surviving from hands to mouth". (Participant 10, 16 years old).

The extracts above indicate that financial difficulties created considerable stress within families as well as amongst the children. This has also affected the students performance at school since there will be no one to provide the needed digital devices used at school. These financial challenges not only affect the parents but also placed a burden on the children, who felt guilty making it difficult for them to concentrate on their own lives, such as their education. In the context of Family Systems Theory, these findings highlighted the interconnectedness of family members and how external stress financial issues influence the entire family unit. The theory posits that the emotional health and behaviour of each member are affected by family dynamics, indicating that increased parental conflict creates a tense environment that shapes all interactions.

Financialstraincreatesanoverwhelmingatmospherethatdisruptsfamilydynamicsandindividualdevelopment.Adolescentsexpressedfeelingsofguiltregardingtheirfamily'sfinancialsituation,complicatingtheirabilitytofocusontheirownlives,suchasacademicpursuits.Thefindingssuggestthattheemotionalburdenoffinancialproblemsextendstoadolescents,whooftenfeeltherepercussionsoftheirparents'stress.Thiscycleofanxietyandtensioncanhinderadolescents'emotionaldevelopmentandoverallqualityoflife,illustratingtheprofoundimpactofeconomicinstabilityonfamilyrelationships.

These findings concur with Mkhize (2021), who emphasizes that economic stress is a key factor leading to ongoing conflicts and instability within marriages. The experiences shared by the participants highlight how financial issues not only create tension between parents but also impact their children's emotional health and extend to their academic life. By applying Family Systems Theory, we can better understand how these financial strains disrupt family dynamics and individual development, reinforcing the notion that challenges faced by one family member resonate throughout the entire system henceforth extend to the education of the student affected.

The causes of these economic factors are multifaceted, including regional disparities, varying family income levels, and insufficient funding for schools in low-income areas. Students in these environments often attend institutions that cannot afford modern technology and infrastructure, further limiting their exposure to innovative teaching methods that incorporate ICT. Scholars such as Warschauer (2004) highlight how the digital divide; rooted in economic inequality, exacerbate educational disparities, particularly in STEM subjects like Physics. This situation reflects the Social Capital Theory, which suggests that individuals' economic resources significantly impact their access to education and opportunities. As a result, students from lower socioeconomic backgrounds frequently miss critical learning experiences involving ICT, perpetuating a cycle of disadvantage that can hinder their future engagement with higher education and careers in STEM fields. To address these economic factors and improve access to ICT in Physics education, collaborative efforts are necessary to ensure equitable educational opportunities for all students, regardless of their economic background.

The lack of access to ICT not only affects students' academic performance but also their development of essential skills needed in a technology-driven world. Without exposure to digital tools, students may struggle to develop critical thinking and problem-solving abilities that are crucial for success in Physics. These skills are increasingly important in higher education and in various career paths, particularly in science and engineering fields where technological proficiency is essential.

Furthermore, the impact of economic factors on ICT access can create a sense of disenfranchisement among students. When they see their peers engaging with advanced technology and learning resources, those without access may feel marginalized or less capable. This emotional and psychological impact can lead to decreased motivation and self-efficacy, further hindering their academic engagement and performance in Physics.

To address these economic factors and improve access to ICT in Physics education, collaborative efforts are necessary. Schools, governments, and communities must work together to ensure equitable educational opportunities for all students, regardless of their economic background. Initiatives such as providing subsidized devices, expanding internet access in underserved areas, and investing in teacher training for effective ICT integration can help bridge the gap. By fostering an inclusive environment where all students have access to the tools and resources they need, we can promote greater equity in Physics education and empower future generations to pursue careers in STEM fields.

4.3.2.2 Digital literacy

Digital literacy plays a crucial role in shaping students' experiences in the teaching and learning of Physics at the Ordinary level, significantly influencing their ability to engage with Information and Communication Technology (ICT). Research indicates that students who possess strong digital literacy skills are more adept at navigating online resources, utilizing educational software, and participating in interactive simulations that are essential for understanding complex Physics concepts. Conversely, students lacking these skills may struggle to effectively engage with digital tools, leading to diminished comprehension and academic performance in the subject. Findings from studies reveal that a significant portion of students, particularly those from disadvantaged backgrounds, often lack the necessary digital literacy, which can hinder their ability to access and utilize ICT resources effectively.

The results showed how digital literacy affected them in the learning and teaching of Physics classes. They described how these experiences made education more stressful and often made it harder for their understanding and adopting to even group discussions with other students who were literate in the digital world.

The following statements affirm this observation:

"As a student navigating my Physics classes, I've come to realize just how much digital literacy impacts my learning experience. When I first started using online resources and educational software, I felt overwhelmed and unsure of how to effectively use these tools. Many of my peers seemed to grasp the technology effortlessly, while I struggled to keep up. This gap in my digital skills made it difficult to engage with interactive simulations and online tutorials that could have

deepened my understanding of complex concepts like forces and motion". (Participant 2, 16 years old).

"In group projects, the lack of my digital literacy often left me feeling excluded. My classmates would collaborate seamlessly using shared documents and online platforms, but I found myself lost and hesitant to contribute. It was frustrating to see how much they could accomplish together while I struggled to catch up. This experience not only affected my academic performance but also impacted my motivation and confidence". (Participant 3, 17 years old).

"I've spoken to my teachers about this, and they recognize the importance of digital literacy in today's learning environment. They've started incorporating more training into our curriculum, which has been helpful. I'm slowly learning to navigate these digital tools, but I still feel anxious about whether I'll be able to keep up in future classes, especially as technology continues to evolve". (Participant; 10, 16 years old).

This situation resonates with the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the integration of technology into teaching practices. According to this theory, teachers must possess not only content knowledge but also the skills to integrate technology effectively in their pedagogy. Without a solid foundation in digital literacy, students may find it challenging to benefit from technology-enhanced learning experiences, thereby limiting their engagement and understanding of Physics. Scholars such as Martin (2006) argue that digital literacy extends beyond mere technical skills, encompassing critical thinking and problem-solving abilities necessary for navigating the digital landscape. Additionally, authors like Buckingham (2007) highlight the importance of media literacy as an integral component of digital literacy, stressing that students need to critically evaluate the information they encounter online to become informed and responsible users of technology.

Moreover, the lack of digital literacy can create barriers to collaborative learning experiences, where students are expected to work together using digital platforms for experiments or projects. When students are not equipped with the skills to use these technologies, they may feel alienated or excluded from group activities, which can further impact their motivation and engagement in Physics. Scholars such as Ito et al. (2013) underscore the importance of social learning in digital environments, suggesting that digital literacy fosters not only individual learning but also collaborative skills that are essential for success in STEM fields.

To address these challenges, it is essential to prioritize digital literacy education in the curriculum, particularly in subjects like Physics that increasingly rely on ICT. Providing targeted training and resources for both students and teachers can help foster an environment where digital literacy is valued and integrated into the learning process. By equipping students with the necessary skills to effectively engage with technology, we can enhance their learning experiences in Physics, promote greater academic achievement, and prepare them for future challenges in a technology-driven world. This holistic approach to digital literacy, as advocated by scholars like Sefton-Green (2013), can empower students to become not just consumers of technology, but also critical thinkers and innovators capable of navigating and contributing to an increasingly complex digital landscape.

Within the framework of Family Systems Theory, this highlights the importance of recognizing that the emotional well-being of individual family members is interconnected with the overall functioning of the family unit. The external pressures faced by parents can disrupt healthy interactions, creating a cycle of dysfunction that impacts all members leading to a state of disequilibrium within the family. Therefore, addressing these societal expectations is crucial for fostering healthier family dynamics and supporting the emotional development of children.

The findings regarding digital literacy align closely with the work of Martin (2006), who emphasizes that digital literacy encompasses not only technical skills but also critical thinking and problem-solving abilities necessary for navigating the digital landscape. Martin's framework highlights the importance of being able to analyze and evaluate information encountered online, which is essential for students like me who are striving to engage effectively with complex subjects such as Physics. As I grapple with using digital tools in my studies, Martin's insights resonate deeply—demonstrating that merely having access to technology is insufficient. Instead, students must develop a comprehensive skill set that includes understanding how to use these tools critically and effectively. This alignment underscores the need for educational institutions to prioritize digital literacy training, ensuring that all students can fully leverage technology to enhance their learning experiences and academic outcomes.

4.4.1 Cultural attitudes and resistance

Cultural attitudes and resistance significantly impact students' teaching and learning of Physics at the Ordinary level, often shaping their perceptions and engagement with the subject. Many students come from backgrounds where science, particularly Physics, is viewed as a challenging and abstract discipline, leading to a cultural stigma that discourages participation. This perception is compounded by the belief that Physics is primarily for "gifted" students, which can create a sense of inadequacy among those who struggle with the mathematical components of the subject. Such cultural attitudes can lead to resistance, where students opt out of Physics in favor of subjects perceived as easier or more relevant to their future careers, thereby narrowing the pipeline for future STEM professionals. Research by Arnot and Furlong (2006) highlights how societal expectations and stereotypes about gender and ability can further entrench these views, making it essential to address these cultural barriers to foster a more inclusive learning environment.

Theories such as Social Cognitive Theory can help explain these dynamics, as they emphasize the role of observational learning and social influences on behavior. According to Bandura's framework, students' beliefs about their capabilities in Physics are influenced by their cultural context and the attitudes of their peers and educators. When students observe their peers expressing fear or disinterest in Physics, they may internalize these attitudes, leading to a self-fulfilling prophecy where they believe they cannot succeed in the subject. This aligns with the findings of scholars like Ito et al. (2010), who argue that social learning environments significantly affect students' engagement and motivation in STEM fields. The lack of positive role models in Physics can exacerbate these challenges, as students may not see individuals from their cultural background succeeding in the discipline, further discouraging them from pursuing it.

Below are the responses given by participants on how cultural attitudes and resistance affect them in the teaching and learing of Physics:

"As a student affected by these cultural attitudes and resistance, I often feel the weight of expectations from my peers and family. Many of my friends have expressed that they find Physics too difficult and have chosen to focus on subjects like Biology or Chemistry, which they perceive as more manageable. This collective mindset creates an environment where pursuing Physics feels like an uphill battle. I sometimes find myself questioning my abilities, especially when I see others excel in subjects that are deemed less challenging. The lack of encouragement and positive reinforcement from my cultural context makes it difficult to stay motivated in my Physics studies". (Participant 4, 16 years old).

"In this school, Physics is often seen as a difficult subject, and this cultural attitude spills over into our use of technology. When we have to use simulations or online resources for our Physics projects, many of my classmates resist engaging with them because they believe they won't understand the material. I remember a group project where we had to use physics simulation software, and most of my friends opted out, saying it was 'too complicated.' This resistance to using ICT tools makes it challenging to explore the subject more interactively. If we had more guidance on how to use these technologies effectively, I think we would feel more empowered to engage with Physics."(Participant 8, 15 years old).

"As a girl in a school where Physics is often considered a 'boys' subject,' I've faced extra challenges when it comes to using ICT in my learning. During our online Physics lab sessions, I often feel overlooked, and my contributions are sometimes dismissed. This cultural attitude makes me hesitant to engage with the technology we use, like simulation software or online quizzes. I think if our teachers emphasized the importance of diversity in STEM fields and how technology can help us all succeed, it would encourage a more inclusive environment where everyone feels comfortable participating."(Participant 6, 15 years old).

These responses highlight how cultural attitudes can create resistance to both Physics and the use of ICT, underscoring the need for educational strategies that promote inclusivity and demonstrate the relevance of technology in understanding scientific concepts. This is echoed in the work of Sefton-Green (2013), who emphasizes the importance of culturally relevant pedagogy in supporting students' identities and learning experiences in science.

The findings on cultural attitudes and resistance in relation to ICT and Physics support several key areas of research that explore the intersection of technology, education, and student engagement. Social constructivist theories, particularly those articulated by Vygotsky (1978), emphasize the role of social interactions and cultural context in learning. This perspective suggests that students' cultural attitudes can significantly impact their willingness to engage with ICT tools in Physics. When a community views Physics as difficult or irrelevant, students may resist using digital resources that could enhance their understanding. This aligns with findings indicating that cultural resistance can hinder the adoption of ICT in educational settings.

Additionally, the concept of the digital divide, highlighted in research by Warschauer (2004), illustrates how disparities in access to technology can lead to unequal educational outcomes. In environments where cultural attitudes discourage the pursuit of Physics, students may also lack the resources or support necessary to effectively utilize ICT. Such disparities reinforce the need for equitable access to technology and training, aiming to foster a more inclusive learning environment. Moreover, research by Carlone and Johnson (2007) on STEM identity formation reveals how cultural attitudes shape students' identities in these fields. Negative perceptions about Physics can contribute to resistance, ultimately affecting students' self-efficacy and sense of belonging. The introduction of ICT tools can either reinforce or challenge these cultural attitudes, depending on how they are integrated into the learning experience.

Studies by Dede (2006) further illustrate how technology can enhance student engagement and motivation in science education. However, if cultural attitudes lead to resistance, students may not fully utilize these technological resources. The importance of creating a supportive environment that encourages the use of ICT to explore Physics concepts is emphasized in these findings, as it can increase student motivation and interest. Finally, the work of Borko (2004) underscores the significance of effective pedagogical strategies that incorporate technology. Research suggests that when teachers demonstrate the practical applications of Physics through ICT, it can help mitigate cultural resistance. Overall, the findings on cultural attitudes and resistance underscore the necessity of addressing these cultural barriers to create a more inclusive and engaging learning environment that fosters positive attitudes toward both Physics and technology.

Moreover, the integration of Information and Communication Technology (ICT) in learning can either mitigate or exacerbate these cultural attitudes. While ICT has the potential to make Physics more accessible through interactive simulations and online resources, students' resistance to engaging with these technologies can hinder their learning. As noted by Buckingham (2007), the effectiveness of digital tools in education is contingent upon students' willingness to embrace them. If cultural attitudes remain negative towards Physics, students may resist utilizing ICT resources that could enhance their understanding and appreciation of the subject. This creates a paradox where technology, which could serve as a bridge to better engagement, becomes another barrier due to students' preconceived notions about their capabilities in Physics.

In conclusion, addressing cultural attitudes and resistance is crucial for improving students' engagement and performance in Physics. Educational interventions that promotes positive cultural perceptions of Physics, alongside effective ICT integration, can help foster a more inclusive and supportive learning environment. By challenging the stigma associated with Physics and encouraging a growth mindset, educators can empower students to overcome resistance and develop a deeper interest in the subject. This can be achieved through collaborative learning experiences that utilize technology, allowing students to see the real-world applications of Physics and encouraging them to explore the subject further. Ultimately, fostering a positive cultural attitude towards Physics, supported by effective teaching practices, will be essential in preparing a diverse and capable future workforce in STEM fields.

4.4.2 Infrastructure issues

Infrastructure issues significantly affect the teaching and learning of Physics at the Ordinary level, impacting students' academic performance and engagement with the subject. Poorly maintained or inadequate school facilities can hinder effective teaching practices and limit students' access to essential resources, such as laboratories and modern technology. Research indicates that the condition of school facilities directly correlates with student achievement, as students in well-maintained environments tend to perform better academically compared to those in deteriorating conditions. This is particularly relevant in the context of Physics education, where hands-on experiments and practical applications are crucial for understanding complex concepts.

The responses that students gave regarding infrastructure issues in relation to learning Physics and using ICT are as follows:

"Our school's Physics lab is outdated and poorly equipped. We don't have the necessary tools or experiments to really understand the concepts we're learning in class. When we do have practical sessions, it often feels more like a lecture than a hands-on experience. If we had better facilities, I believe we could engage more with the material and really grasp the principles of Physics." (Participant 3, 17 years old.)

"I find it really frustrating that our school lacks reliable internet access. We often can't use online resources or simulations that could help us understand complex Physics topics. For instance, there are great physics simulation apps that would make learning about forces and motion so much easier, but without good infrastructure, we miss out on those opportunities. It feels like we're falling behind compared to other schools that have better tech access." (Participant 5, 16 years old).

"During our lessons, we sometimes have to share outdated textbooks or resources. This makes it hard to keep up with the curriculum. I think if we had a better library

and more up-to-date materials, it would help us prepare for our exams more effectively. Having access to modern ICT resources, like e-books and interactive learning tools, could make a huge difference in our understanding of Physics concepts." (Participant 9,17years old).

These responses illustrate how infrastructure issues can directly impact students' learning experiences in Physics and their ability to engage with ICT effectively. They emphasize the need for improved facilities, resources, and access to technology to enhance educational outcomes.

Theoretical frameworks, such as the Social Constructivist Theory, emphasize the importance of the learning environment in shaping students' educational experiences. According to Vygotsky (1978), social interactions and the physical context of learning play a vital role in cognitive development. Inadequate infrastructure can create barriers to these interactions, leading to disengagement and a lack of motivation among students. For instance, if a school lacks proper laboratory facilities, students may miss out on critical experiential learning opportunities that are essential for grasping Physics concepts. This aligns with findings from various studies that highlight how infrastructure deficiencies can exacerbate educational inequalities, particularly in subjects like Physics that require significant practical engagement.

Moreover, the integration of Information and Communication Technology (ICT) in Physics education is often hampered by infrastructure issues. Scholars have noted that while ICT has the potential to enhance learning experiences and improve student outcomes, its effectiveness is contingent upon the availability of adequate technological resources and supportive infrastructure For example, during the COVID-19 pandemic, many schools faced challenges in transitioning to online learning due to insufficient digital infrastructure, which resulted in learning losses and widened educational gaps. This situation underscores the necessity for schools to invest in both physical and digital infrastructures to facilitate effective teaching and learning in Physics.

The above findings collaborate with Uwizeyimanaetal, (2018) who discusses about theinadequatetechnological infrastructureineducationalinstitutions,particularlyindevelopingcountries,andits impaction ICTintegrationinPhysicseducation.TheintegrationofInformationandCommunicationTechnology(ICT)intheteachingandlearningofPhysicsattheOrdinaryLevelfacesseveralchallengesthathinderitseffectiveness.Onesignificantbarrieristheinadequatetechnologicalinfrastructureinmanyeducationalinstitutions,particularlyindevelopingcountries. The above findings also agree with research which indicatesthattheextentofICTintegrationinKenyansecondaryschoolsisbelow32%,highlightingacriticalgapinresourcesandsupportforteachersandstudentsalike(Tondeuretal.,2015).Thislackofinfrastructureiscompoundedbylimitedaccesstoreliableinternetconnectivity,whichrestrictsbothteachers'andstudents'abilitytoutilizeonlineresourcesandtoolsthatcouldenhancethelearning experience.

Furthermore, the digital divide, as discussed by Warschauer (2004), highlights how disparities in access to technology can lead to unequal educational outcomes. In contexts where cultural attitudes discourage the pursuit of Physics, students may also lack the resources or support necessary to effectively utilize ICT. This reinforces the need for equitable access to technology and training, aiming to foster a more inclusive learning environment. The findings on infrastructure issues resonate with the broader discourse on educational equity, emphasizing that improvements in school facilities and access to technology are essential for enhancing student engagement and achievement in Physics.

In conclusion, infrastructure issues play a critical role in shaping the teaching and learning of Physics at the Ordinary level. By addressing these challenges and investing in both physical and digital resources, educational institutions can create a more conducive environment for student learning, ultimately leading to improved academic outcomes in Physics.

4.4.3 Pedagogical Challenges

Pedagogical challenges significantly affect the teaching and learning of Physics at the Ordinary level, influencing students' understanding and engagement with the subject. One of the primary challenges is the reliance on traditional teaching methods, which often emphasize rote memorization over conceptual understanding. This approach can lead to superficial learning, where students pass exams without truly grasping the underlying principles of Physics. Research by Hattie (2009) indicates that when teachers do not adopt more interactive and student-centered pedagogies, students struggle to connect theoretical concepts with practical applications, which is crucial in a subject like Physics that relies heavily on experimentation and real-world relevance.

These are some responses that the key informant gave regarding the pedagogical challenges affecting the teaching and learning of Physics at the Ordinary level:

"I often find that my students struggle with understanding Physics concepts because we rely heavily on traditional lectures. While I try to incorporate some interactive elements, it's challenging to shift the entire classroom culture. I believe that if we had more resources for inquiry-based learning, it would help students engage more deeply with the material. They need hands-on experiences to truly grasp the principles of Physics." (Key informant 1, 45 years old)

"Adopting a constructivist approach in my teaching has been transformative, but it also comes with challenges. Not all students are used to this kind of learning environment, and some find it overwhelming. I need to provide more support and scaffolding to help them develop the skills needed for inquiry-based learning. It's a process, but I believe it's worth it for their long-term understanding of Physics." (key informant 4, 32 years old).

These responses reflect the challenges teachers face in adapting their pedagogical approaches to improve student engagement and understanding in Physics, particularly in relation to the integration of ICT and the necessity of addressing infrastructure issues.

Constructivist Learning Theory highlights the importance of active engagement in the learning process. According to Piaget (1973), students construct their understanding through experiences and interactions with their environment. When pedagogical practices do not align with this approach, students may become disengaged and disinterested in Physics. For instance, a study by Minner et al. (2010) found that students who participated in inquiry-based learning, which encourages exploration and experimentation, demonstrated a deeper understanding of Physics concepts compared to those who experienced traditional lecture-based instruction. This finding underscores the need for educators to adopt pedagogical strategies that foster critical thinking and problem-solving skills, which are essential for success in Physics.

Moreover, the integration of Information and Communication Technology (ICT) in Physics education presents both opportunities and challenges. While ICT can enhance learning by providing access to simulations, interactive resources, and collaborative tools, many teachers face difficulties in effectively incorporating these technologies into their teaching practices. Researchers like Ertmer and Ottenbreit-Leftwich (2010) have noted that inadequate training and support for teachers in using ICT can lead to underutilization of these resources, ultimately hindering students' learning experiences. For example, students may miss out on valuable opportunities to engage with dynamic simulations that illustrate complex Physics phenomena, which could enhance their conceptual understanding and interest in the subject.

Furthermore, the digital divide exacerbates pedagogical challenges, particularly in under-resourced schools where access to technology is limited. Warschauer (2004) discusses how students from disadvantaged backgrounds may struggle to engage with ICT tools that are increasingly essential for learning in the 21st century. This disparity can lead to unequal educational outcomes, as those with limited access to technology may find it challenging to keep up with their peers. Addressing these pedagogical challenges requires a concerted effort to improve teacher training, invest in infrastructure, and create inclusive learning environments that leverage the potential of ICT to enhance Physics education.

The above resonates with Kipyator,(2017) who is of the view that many educators continue to rely on teacher-centred methods that do not foster active learning or critical thinking, which are essential for understanding complex scientific concepts.isdisconnectcanleadtostudentdisengagementandaperceptionofPhysicsasadif ficultandirrelevantsubject(Owenetal,2018).TheoriessuchasConstructivismemphasizet heimportanceofactivelearningandstudentengagementinthelearningprocess,suggesting thattheintegrationofICTshouldbeaccompaniedbypedagogicalshiftstowardsmorestude nt-centeredapproaches(Rieckmann,2018).

In conclusion, pedagogical challenges significantly impact the teaching and learning of Physics at the Ordinary level. By adopting more effective teaching strategies aligned with Constructivist principles and integrating ICT thoughtfully, educators can create a more engaging and supportive learning environment that fosters students' understanding and appreciation of Physics.

4.4.4 Insufficient Training

From the findings, many teachers articulated a profound fear on iinsufficient training for teachers significantly impacts the teaching and learning of Physics at the Ordinary level, leading to various pedagogical challenges that hinder student engagement and understanding. Many educators lack the necessary skills to effectively integrate Information and Communication Technology (ICT) into their teaching practices, which is crucial in today's technology-driven educational landscape. Research indicates that when teachers are not adequately trained in using ICT tools, they tend to rely on traditional teaching methods that emphasize rote memorization rather than fostering critical thinking and problem-solving skills essential for mastering Physics concepts (Ertmer & Ottenbreit-Leftwich, 2010). This reliance on outdated pedagogical approaches can result in students developing a superficial understanding of Physics, as they are not provided with opportunities to engage in hands-on experiments or inquiry-based learning that promote deeper comprehension (Minner et al., 2010).

The extracts below assert this observation:

"*The digital divide is a significant issue in my classroom. Many of my students come from backgrounds where they don't have access to technology at home, and without adequate training, I find it hard to bridge this gap. I want to use online resources to enhance their understanding of Physics, but I often feel ill-equipped to do so, which limits what I can offer them." (key informant 3, 39 years old).*

"During the transition to remote learning, it became painfully clear how unprepared many of us were to effectively teach online. The training I received was minimal, and I struggled to keep my students engaged in Physics through a screen. This experience highlighted the urgent need for more comprehensive professional development focused on using ICT in teaching, especially in subjects like Physics that thrive on interaction and experimentation." (key informant 2, 40 years old).

These responses reflect the challenges teachers face due to insufficient training, emphasizing how it affects their ability to engage students and utilize ICT effectively in Physics education.

Theoretical frameworks such as Constructivist Learning Theory emphasize the importance of active engagement in the learning process, where students construct their understanding through experiences and interactions (Piaget, 1973). However, without sufficient training, teachers may struggle to implement these constructivist principles effectively in their classrooms. This disconnect can lead to a lack of motivation among students, who may find Physics concepts abstract and difficult to relate to real-world applications. As noted by Warschauer (2004), the digital divide exacerbates these challenges, particularly in under-resourced schools where access to technology is limited. Students from disadvantaged backgrounds may miss out on valuable learning experiences that could enhance their understanding of Physics, further widening the achievement gap.

Moreover, the integration of ICT in Physics education has been shown to improve student engagement and comprehension when implemented effectively. For instance, interactive simulations and digital resources can provide students with visualizations of complex concepts, making them more accessible and easier to understand (Ganasen & Shamuganathan, 2017). However, if teachers are not trained to utilize these tools, students may not benefit from the potential advantages that ICT offers in enhancing their learning experiences. Research by Hattie (2009) highlights that effective teaching practices, including the use of technology, are critical for improving student outcomes in subjects like Physics. Therefore, addressing the issue of insufficient training for teachers is essential to ensure that students receive a quality education that prepares them for future challenges in the field of Physics and beyond.

Insufficient training for teachers significantly affects the teaching and learning of Physics at the Ordinary level by perpetuating pedagogical challenges that hinder student engagement and understanding. By investing in professional development and training programs that focus on integrating ICT into Physics education, educators can create more dynamic and effective learning environments that foster critical thinking and problem-solving skills among students.

4.5.1 Professional development

Professional development (PD) plays a crucial role in shaping the teaching and learning of Physics at the Ordinary level, significantly influencing student outcomes. Effective PD equips teachers with the necessary skills and knowledge to integrate Information and Communication Technology (ICT) into their teaching practices, which is essential for fostering an engaging and interactive learning environment. Research indicates that when teachers participate in high-quality PD programs, they are more likely to adopt innovative teaching strategies that enhance student understanding of complex Physics concepts (Desimone & Stuckey, 2014). For instance, PD that focuses on inquiry-based learning and the use of digital tools can lead to improved student engagement and achievement in Physics, as students are encouraged to explore and experiment with scientific principles actively.

Here are some responses from teachers regarding the impact of professional development on the teaching and learning of Physics at the Ordinary level:

"Professional development has been a game changer for me. The workshops I attended on integrating technology into my Physics lessons opened my eyes to new teaching strategies. I now use simulations and digital resources, which engage my students much more than traditional lectures ever did. I can see their understanding deepening as they interact with the material." (key informant 4, 32 years old)

"While I recognize the importance of PD, I've often felt that the training sessions I attended were too theoretical and didn't provide practical strategies for integrating ICT effectively. I want to use technology to enhance my Physics teaching, but without hands-on training, I struggle to implement what I learn. This gap leaves my students missing out on valuable learning experiences." (key informant 1, 45 years old).

"I've found that many teachers at my school share the same concerns about the effectiveness of PD. We often leave these sessions feeling inspired but unsure how to apply what we learned in our Physics classes. Comprehensive training that includes practical applications of ICT would make a huge difference in how we teach." (key informant 3, 39 years old).

"The digital tools I learned about in my recent PD session have transformed my Physics classroom. Students are now able to visualize complex concepts through simulations, which has helped them grasp difficult topics much more easily. However, I wish there were more follow-up sessions to reinforce these skills and share best practices among teachers." (key informant 2, 40 years old).

These responses reflect the experiences of teachers regarding professional development, highlighting both the benefits and challenges they face in integrating new strategies and technologies into their Physics instruction.

Theoretical frameworks such as Constructivist Learning Theory emphasize the importance of active learning, where students construct their understanding through experiences and interactions (Piaget, 1973). However, insufficient training in ICT and modern pedagogical approaches can hinder teachers' ability to implement these principles effectively. Scholars have noted that many PD programs still rely on traditional methods that do not adequately prepare teachers to integrate technology into their classrooms (Ertmer & Ottenbreit-Leftwich, 2010). This gap in training can lead to a reliance on outdated teaching practices, which may not resonate with students who are accustomed to interactive and technology-enhanced learning experiences.

Moreover, the integration of ICT in Physics education has been shown to improve student comprehension when implemented effectively. For example, interactive simulations and digital resources can provide students with visualizations of complex concepts, making them more accessible (Ganasen & Shamuganathan, 2017). However, if teachers lack the training to utilize these tools, students may miss out on the benefits that technology can offer in enhancing their learning experiences. Research by Hattie (2009) highlights that effective teaching practices, including the use of technology, are critical for improving student outcomes in subjects like Physics. Therefore, addressing the issue of insufficient training for teachers is essential to ensure that students receive a quality education that prepares them for future challenges in the field of Physics and beyond.

In conclusion, professional development significantly affects the teaching and learning of Physics at the Ordinary level by equipping teachers with the skills necessary to integrate ICT effectively. Insufficient training can lead to pedagogical challenges that hinder student engagement and understanding, ultimately impacting their academic performance. By investing in comprehensive PD programs that focus on modern teaching strategies and technology integration, educators can create more dynamic and effective learning environments that foster critical thinking and problem-solving skills among students.

4.5.2Curriculum Constraints

Curriculum constraints significantly affect the teaching and learning of Physics at the Ordinary level, creating barriers that hinder student engagement and understanding. These constraints often manifest as rigid syllabi that prioritize content coverage over deep learning, leaving little room for inquiry-based approaches that are essential for grasping complex scientific concepts. Research indicates that when teachers feel pressured to cover extensive material, they may resort to traditional lecturing methods, which do not foster critical thinking or problem-solving skills among students (Minner et al., 2010). This approach is particularly detrimental in Physics, where conceptual understanding is crucial for success. Theoretical frameworks such as Constructivist Learning Theory emphasize the importance of active engagement in the learning process, suggesting that students learn best when they can explore and manipulate concepts rather than passively receive information (Piaget, 1973).

Below are some responses from teachers regarding the impact of curriculum constraints on the teaching and learning of Physics at the Ordinary level:

"The curriculum is so packed that I often feel rushed to cover all the material. This pressure leads me to focus on rote memorization rather than helping students understand the underlying concepts in Physics. I wish there was more flexibility to explore topics in depth or to incorporate hands-on activities that could make the subject more engaging." (key informant 2, 40 years old)

"I feel that the curriculum constraints create a disconnect between what we teach and what students actually need to learn in the real world. In today's technology-driven environment, it's crucial to integrate ICT into our teaching, but the curriculum doesn't support that. As a result, my students may not be fully prepared for the challenges they will face in higher education or in their careers." (key informant 4, 32 years old).

"The pressure to cover the entire curriculum often leaves me feeling overwhelmed. I believe that if we could have a more streamlined syllabus that allows for deeper exploration of key concepts, students would be much more engaged and successful

in Physics. The current constraints just don't support meaningful learning experiences." (key informant 3, 39 years old).

These responses reflect the challenges teachers face due to curriculum constraints, emphasizing how these limitations affect their ability to engage students and integrate technology in Physics education.

Moreover, insufficient training for teachers exacerbates the challenges posed by curriculum constraints. Many educators lack the necessary skills to effectively integrate Information and Communication Technology (ICT) into their teaching, which is vital for enhancing student learning in today's digital age. Ertmer and Ottenbreit-Leftwich (2010) highlight that without adequate training, teachers may struggle to utilize ICT tools that could facilitate interactive and engaging learning experiences in Physics. This lack of technological integration can lead to a disconnect between students' learning experiences and the skills they need to succeed in a technology-driven world. Scholars have noted that the digital divide further complicates this issue, as students from disadvantaged backgrounds may not have access to the same technological resources, limiting their opportunities to engage with Physics content meaningfully (Warschauer, 2004).

In conclusion, curriculum constraints and insufficient training for teachers significantly impact the teaching and learning of Physics at the Ordinary level. By prioritizing content coverage over student engagement and failing to equip educators with the necessary skills to integrate ICT effectively, these challenges hinder students' ability to develop a deep understanding of Physics concepts. Addressing these issues through comprehensive professional development and curriculum reform is essential to create a more effective and equitable learning environment for all students.

CHAPTER 5

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter will explore the findings of the study within the context of its objectives and the existing literature. The discussion will begin by examining the challenges associated with the integration of Information and Communication Technology (ICT) in the teaching and learning of Physics at the Ordinary level. As educational institutions increasingly recognize the importance of ICT in enhancing student engagement and understanding, it becomes crucial to identify and address the barriers that hinder effective implementation. This chapter will explore various constraints faced by educators and students in integrating ICT into Physics education, including pedagogical challenges, resource limitations, the digital divide, and administrative support. By examining these issues, this chapter aims to provide a comprehensive understanding of the current landscape of ICT integration in Physics teaching and learning.

5.2 Summary of the Project

This research project aimed to investigate the challenges of ICT integration in the teaching and learning of Physics at the Ordinary level. Through qualitative and quantitative methods, data were collected from educators, students, and administrators to identify key obstacles. The findings revealed several constraints:

5.2.1 Lack of Adequate Training for Teachers

Many educators reported feeling unprepared to use ICT tools effectively in their teaching practices. Without proper training, teachers may resort to traditional methods, limiting the potential benefits of technology in enhancing the learning experience. A significant number of teachers lack familiarity with various ICT resources, such as simulation software, online learning platforms, and interactive teaching tools. This gap in knowledge can lead to frustration and reluctance to adopt new technologies, ultimately hindering their integration into the classroom. Moreover, even when teachers are provided with training opportunities, these sessions are often brief and do not offer ongoing support, leaving educators without the confidence to experiment with ICT in their teaching. Furthermore, the rapid evolution of technology means that training programs can quickly become outdated, failing to equip teachers with the latest skills and tools necessary for effective instruction.

5.2.2. Insufficient Technological Resources

The integration of ICT in Physics education is severely hampered by the lack of adequate technological resources. Many schools struggle with outdated or insufficient hardware, such as computers and projectors, which are essential for delivering engaging lessons. Inadequate access to reliable internet connections further complicates matters, as many online resources and interactive simulations cannot be utilized effectively. Additionally, the availability of software that aligns with the Physics curriculum is often limited, restricting teachers' ability to use technology to its full potential. This scarcity of resources can lead to a reliance on traditional teaching methods, which may not adequately engage students or facilitate a deeper understanding of complex Physics concepts. Furthermore, budget constraints often prevent schools from investing in the latest technological advancements, creating a cycle of underinvestment that perpetuates these challenges. In many cases, schools may lack dedicated IT support staff, making it difficult to troubleshoot technical issues or maintain equipment, further deterring teachers from incorporating ICT into their lessons.

5.2.3. Rigid Curricula

The existing curricula often prioritize content coverage over innovative teaching methods. This rigidity restricts teachers from incorporating ICT and inquiry-based approaches that could foster deeper understanding of Physics concepts. Many curricula are designed with a focus on standardized testing and specific outcomes, leaving little room for flexibility in teaching styles. As a result, teachers may feel pressured to adhere strictly to the prescribed content, limiting their ability to adapt lessons to incorporate ICT tools effectively. This lack of adaptability can stifle creativity and discourage educators from exploring new instructional strategies that could enhance student engagement. Moreover, the emphasis on traditional assessment methods often leads to a culture of memorization, where students focus on rote learning rather than developing critical thinking and problem-solving skills essential in Physics. Consequently, this rigid approach can alienate students who might benefit from more interactive and technology-driven learning experiences.

5.2.4. Digital Divide

The digital divide represents a significant barrier to effective ICT integration in Physics education. Many students come from varying socioeconomic backgrounds, resulting in disparities in access to technology both at school and at home. Students from affluent families often have access to computers, high-speed internet, and educational apps that facilitate learning, while their less privileged peers may struggle to access even basic technological tools. This unequal access creates a significant gap in learning opportunities, as students unable to utilize ICT resources are at a disadvantage when it comes to engaging with the curriculum. Moreover, the digital divide extends beyond mere access to technology; it also encompasses disparities in digital literacy. Students who have not had exposure to technology may find it challenging to navigate online resources or software, further widening the gap in achievement. Addressing the digital divide is crucial for ensuring that all students can benefit from ICT-enhanced educational experiences, fostering an equitable learning environment in Physics education.

5.2.5. Administrative Support

The role of school administration is vital in facilitating or hindering the integration of ICT in Physics education. A lack of support from school leaders can create an environment where teachers feel isolated in their efforts to adopt new technologies. Without a clear vision or commitment to integrating ICT into the curriculum, initiatives may lack direction and fail to gain traction. Administrators play a critical role in allocating resources, providing training, and fostering a culture of innovation within the school. When administrators prioritize ICT integration and actively support teachers in their efforts, it can lead to significant improvements in teaching practices and student engagement. Conversely, if administrators are unsupportive or indifferent, teachers may feel discouraged from exploring ICT options, perpetuating a cycle of underutilization. Furthermore, administrative policies that focus solely on standardized testing may discourage teachers from adopting innovative practices that incorporate technology, as they may feel pressured to cover prescribed content rather than adapt to student needs.

5.2.6. Infrastructure issues

Infrastructure plays a critical role in the successful integration of Information and Communication Technology (ICT) in Physics education, yet it often presents significant challenges. Many schools lack the foundational physical and technological infrastructure necessary for effective ICT use. This includes not only outdated or insufficient hardware, such as computers and projectors, but also inadequate electrical supply and poor internet connectivity, which can severely limit the functionality of ICT tools. In some cases, classrooms may not be equipped with the necessary facilities for implementing technology-enhanced learning, such as adequate wiring for computer labs or spaces conducive to collaborative learning. Furthermore, maintenance and technical support for existing infrastructure are often lacking, leading to frequent breakdowns and disruptions that hinder the teaching process. Without a robust infrastructure, the potential benefits of ICT in enhancing student engagement and understanding in Physics remain unrealized, creating an environment where traditional teaching methods prevail despite the availability of technology. Addressing these infrastructural constraints is essential for fostering an educational environment that fully leverages the advantages of ICT in Physics education.

5.2.7. Pedagogical Challenges

Pedagogical challenges represent a significant constraint to the effective integration of Information and Communication Technology (ICT) in Physics education. Many educators are accustomed to traditional teaching methods that emphasize direct instruction and rote memorization, which can be at odds with the interactive and student-centered approaches that ICT facilitates. Teachers may struggle to adapt their instructional strategies to incorporate technology in ways that promote critical thinking, problem-solving, and inquiry-based learning. Additionally, there is often a lack of understanding regarding how to leverage ICT tools to enhance the learning experience rather than merely using them as supplementary resources. This disconnect can lead to superficial integration, where technology is used without a clear pedagogical purpose, ultimately failing to engage students meaningfully. Furthermore, teachers may face resistance from students who are unfamiliar with or skeptical about the effectiveness of technology in learning. Overcoming these pedagogical challenges requires a shift in mindset and practice, emphasizing the need for professional development

that focuses on innovative teaching strategies that integrate ICT effectively within the Physics curriculum.
The data highlighted the need for a more supportive framework that fosters the integration of ICT in Physics education, ultimately enhancing student learning outcomes.

5.3 Conclusion

This research has illuminated several critical aspects of the integration of Information and Communication Technology (ICT) in Physics education at the Ordinary level in Zimbabwe, addressing key research objectives.

Firstly, the key infrastructural challenges affecting ICT integration include inadequate technological resources, poor internet connectivity, and insufficient physical facilities conducive to technology-based learning. Many schools lack the necessary hardware and reliable internet access, which hinders both teachers' and students' ability to utilize ICT tools effectively. This infrastructural deficit creates an environment where traditional teaching methods dominate, limiting the potential benefits of technology-enhanced learning.

Secondly, the level of teacher training and professional development significantly influences the integration of ICT in Physics education. Educators who receive comprehensive training are more likely to embrace innovative teaching methods that incorporate technology effectively. Conversely, teachers who lack adequate training often revert to conventional instructional approaches, undermining the transformative potential of ICT. Continuous professional development is essential to equip teachers with the skills and confidence needed to integrate ICT into their teaching practices.

Lastly, a range of strategies can be employed to address these challenges and improve ICT integration in Physics education. These strategies include investing in technological infrastructure, providing ongoing professional development for teachers, revising curricula to allow for flexibility and innovation, and fostering administrative support for ICT initiatives. Additionally, efforts must be made to bridge the digital divide, ensuring that all students, regardless of their socioeconomic background, have access to the necessary technology and resources.

In conclusion, addressing the infrastructural challenges, enhancing teacher training, and implementing targeted strategies are vital steps toward achieving effective ICT integration in Physics education at the Ordinary level. By doing so, we can create a more engaging and equitable learning environment that prepares students for the demands of the 21st century.

5.4 Recommendations

To effectively tackle the challenges of ICT integration in Physics education, based on the findings presented, the study recommends the following recommendations:

5.4.1. Enhance Technological Infrastructure

- Upgrade Hardware and Software: Schools should prioritize the acquisition of modern computers, interactive whiteboards, projectors, and relevant software packages that facilitate Physics education. This may involve seeking funding from government grants, NGOs, or private sector partnerships.
- Improve Internet Connectivity: Ensure that all classrooms have access to high-speed internet. This could involve collaborating with local internet service providers to establish reliable connections, especially in rural areas.
- Maintenance and Technical Support: Establish a dedicated IT support team in schools to maintain equipment and provide technical assistance to teachers and students, ensuring that technology remains functional and accessible.

5.4.2. Implement Comprehensive Teacher Training Programs

- Regular Workshops and Seminars: Organize workshops that focus on specific ICT tools, such as simulation software or online teaching platforms, with practical applications in Physics education.
- Peer Mentoring Programs: Create a peer mentoring system where more experienced teachers assist their colleagues in integrating ICT into their lessons, fostering a collaborative learning environment.
- Online Training Modules: Develop online courses that allow teachers to learn at their own pace, covering a variety of ICT-related topics relevant to Physics instruction.

5.4.3. Revise Curricula for Flexibility

- Incorporate ICT Standards: Integrate ICT competencies into the Physics curriculum, allowing teachers to design lessons that utilize technology to meet learning objectives.

- Project-Based Learning: Encourage the use of project-based learning approaches that enable students to engage with Physics concepts through real-world applications using ICT tools.
- Regular Curriculum Review: Establish a committee to review and update the curriculum periodically, ensuring it remains relevant and incorporates advancements in technology and pedagogy.

5.4.4. Foster Administrative Support

- Leadership Training: Provide training for school leaders on the importance of ICT in education and how to support teachers in implementing these technologies.
- Resource Allocation: Ensure that budgets reflect a commitment to technology integration, allowing for necessary purchases, training, and maintenance.
- Recognition and Incentives: Develop recognition programs for teachers who effectively integrate ICT into their teaching, motivating others to follow suit.

5.4.5. Bridge the Digital Divide:

- Device Distribution Programs: Implement initiatives to provide laptops or tablets to students in need, possibly through partnerships with local businesses or governmental support.
- Community Internet Access Initiatives: Collaborate with local governments to establish community Wi-Fi hotspots, allowing students to access online resources outside of school.
- Digital Literacy Programs: Offer workshops for students and parents on using technology effectively, ensuring that all parties are equipped to engage with ICT resources.

5.4.6. Encourage Collaborative Learning:

- Group Projects and Assignments: Design assignments that require students to work in groups using ICT tools, fostering collaboration and communication skills.
- Online Collaboration Platforms: Utilize platforms like Google Classroom or Microsoft Teams to facilitate group work and discussions, enabling students to collaborate in real-time.
- Interdisciplinary Projects: Encourage projects that combine Physics with other subjects, utilizing ICT to research and present findings, thus enriching students' learning experiences.

5.4.7. Monitor and Evaluate ICT Integration:

- Feedback Mechanisms: Create surveys and focus groups for teachers and students to gather insights on the effectiveness of ICT tools in the classroom, identifying areas for improvement.
- Performance Metrics: Develop clear metrics for assessing the impact of ICT integration on student learning outcomes, such as engagement levels and academic performance in Physics.
- Regular Reporting: Establish a system for reporting findings to stakeholders, ensuring transparency and accountability in efforts to integrate ICT into Physics education.

By providing these detailed recommendations, stakeholders can take actionable steps toward enhancing the integration of ICT in Physics education, ultimately leading to improved teaching practices and better learning outcomes for students.

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APPENDICES

Appendix 1

ConsentFormforParticipationinClassroomObservationsResearch

TitleofStudy: Challenges of(ICT) Information and Communication Technology integration in the teaching and learning of Physics at Ordinary level.

PrincipalInvestigator:

ContactInformation:

Institution:

PurposeoftheStudyThepurposeofthisresearchistoobserveandevaluatethe challenges of(ICT) Information and Communication Technology integrationthe teaching and learning of Physicsat Ordinary level.Yourparticipationwillhelpusunderstandtheeffectivenessofthesetoolsinenhancingstudentlearningandengagement.

Participation-Youarebeinginvitedtoparticipateinthisresearchstudyasan observation onthe subject.Yourinvolvement will include allowing researcherstoobserveyourclassroomduringaPhysicslessonandcompleteachecklistbasedonspecificcriteriarelatedtoICTuse.

VoluntaryParticipation-
Yourparticipationinthisstudyisentirelyvoluntary.Youmaychoosetowithdrawatanytimewithoutanynegativeconsequences.

Confidentiality-
Alldatacollectedduringthisresearchwillbekeptconfidential.Identifyinginformationwillnotbelinkedtoyourresponses,andtheresults will be reportedinaggregateformonly.

RisksandBenefits-
Therearenoforeseeablerisksassociatedwithparticipatinginthisstudy.Whilethere may be nodirectbenefitstoyou,yourparticipationmaycontributetotheimprovementofteachingpracticesandstudentlearningoutcomes.

Consent:Bysigningbelow,youindicatethatyouhavereadandunderstoodtheabove information, andyouagreetoparticipateinthisstudy.

Participant'sName:____

Participant'sSignature:___________________________________

Date:____

NB If you have any questions about this study; please feel free to contacttheprincipalinvestigatoratthecontactinformationprovidedabove.

Appendix 2

INTERVIEW QUESTIONS

1. What specific challenges do you face when using ICT in your Physics classes?

2. How available are ICT tools like computers and internet access in your school?

3. Have you participated in any training programs about using ICT in teaching Physics?

4. How has your training influenced your ability to use ICT in your teaching?

5. Does the current Physics curriculum support the use of ICT tools?

6. Are there any cultural beliefs that affect the use of ICT in your Physics classes?

7. How do economic issues impact your school's ability to use ICT in Physics education?

8. How effective do you think ICT is in engaging students and helping them understand Physics?

9. What support do you get from the school administration for using ICT in your teaching?

10. What strategies do you think could help improve the use of ICT in teaching Physics?

Appendix 3

CLASSROOM OBSERVATIONS

Observations item	**Response**
Are computers, projectors, and other ICT tools available in the classroom during the lesson?	
Does the teacher use ICT tools during the Physics lesson?	
Are students actively using ICT tools in their learning activities?	
Does the teacher have knowledge of ICT integration techniques during the lesson?	
Is the lesson plan aligned with the Physics curriculum and does it incorporate ICT?	
Is the classroom environment for using ICT tools?	
Do students collaborate with each other while using ICT tools?	
Are there any challenges, like technical issues, that arise during the lesson?	
Does the teacher's approach change when using ICT compared to traditional methods?	
Does the teacher provide feedback on student use of ICT during the lesson?	