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INTEGRATION OF ICT IN PHYSICS EDUCATION: CURRENT PRACTICES, TRENDS AND CHALLENGES. CASE STUDY OF 4 SECONDARY SCHOOLS IN BUHERA DISTRICT.

By

Chigumbate Blessing

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Declaration

I Chigumbate Blessing Tatenda declare to the senate of Bindura University of Science Education that this research is my own work except where acknowledged. It is submitted for the degree of Bachelor of Science Hons degree in Education Physics at Bindura University of Science Education-Zimbabwe. It has not been submitted before any other degree of examination at any other university. The findings, interpretations and conclusions expressed in the study neither reflect the views of Bindura University of Science Education, department of science education.

Signature:

Date: AUG 2024

Approval Form

This undersigned certifies that they have understood, approved and recommended to Bindura University of Science Education for the acceptance of this dissertation titled **"INTEGRATION OF ICT IN PHYSICS EDUCATION: CURRENT PRACTICES, TRENDS AND CHALLENGES. CASE STUDY OF 4 SECONDARY SCHOOLS IN BUHERA DISTRICT."**

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In partial fulfillment of the requirement of the HBScEDPh.

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Dedication

I am dedicating this project to my replicas Liam Rutendo (Son) and Tehillah Alexandria (Daughter) Chigumbate. For me to be called Father it's all because of you. This project is the foundation for your academic journey.

Abstract

The study focused at the integration of ICT in the physics education: current practices, trends and challenges. The research objectives looked at the examination of the current practices of ICT integration in physics education, identification of emerging trends in ICT integration in physics education, analysing the challenges and barriers to effective ICT integration in physics education and exploring strategies and best practices for overcoming challenges in ICT integration. The research used a quantitative research approach. The population of the study consists of physics teachers. The researcher used random sampling technique. The researcher used interview guide in interviewing school head, physics teachers and science schools inspector. A total of ten completed the responses from the interview. The researcher in carrying out the research made sure that they follow research ethics. The results indicated that physics teachers has low integration of ICT in the teaching and learning of physics, internet and ICT gadgets are the emerging trends which can be used in the teaching and learning of physics, teachers have challenges in the integration of ICT in the teaching and learning of physics and there is need for teacher capacitation programs so as to equip teachers with essential ICT skills which they can integrate them in the teaching and learning. The study recommends teachers should be provided with teacher capacitation programs such as those sponsored by Ministry of Primary and Secondary Education in conjunction with UNESCO, teachers should be provided with in-house workshops and seminars so as to equip teachers with ICT skills meant to support for the integration of ICT in physics and there is need for retrain of teachers who has been certified with education qualification way back before the introduction of ICT in colleges and universities.

Acknowledgement

This day I reflect back on where I came from I see the faithfulness of God and his love. I would like to thank the Almighty for qualifying the unqualified. My special thanks and honour also goes to my Supervisor Dr Mudzamiri E for his love, academic guidance, endurance, patience and wisdom, he is a father. When my going tend to go towards the valley he advised and his fatherly love I see this day honouring him. This project would be flop without my wife Edith Tatenda Mudhefi Chigumbate who stood by me in our days of trial and tribulation. She stood fast and proved to be a mother. My parents Mr and Mrs (Sekuru naMbuya) Chigumbate for your dream has come to success. My friend and small brother Chikunya Privilege Takura for all the academic guidance. You showed the way and paved the way. To the unnamed I love you all.

Acronyms

MoPSE…..Ministry of Primary and Secondary Education

ICT …..Information Communication Technology

DSI….. District Schools Inspector

SI… Schools Inspector

FGD….. Focus Group Discussion

GoZ …. Government of Zimbabwe

UNDP…. United Nations Development Program

UNICEF …. United Nations Children Emergency Fund

TPACK …….. Technological Pedagogical Content Knowledge

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CHAPTER ONE

INTRRODUCTION AND ITS SETTING

1.0 Introduction

The integration of Information and Communication Technology (ICT) in education has transformed the way students learn and teachers deliver instruction. In the field of physics education, ICT has the potential to enhance students' understanding of complex concepts, promote active learning, and provide access to a wealth of resources and simulations. This chapter therefore covers the background to the study, a concise statement of the problem, research objectives, and research questions, justification of the study, terminology for the study, delimitation and limitations of the study. The primary outputs from the study is to assess the integration of ICT in physics education looking at the current practices, trends and challenges.

1.1 Background of the study

The integration of Information and Communication Technology (ICT) in education has gained significant attention in recent years, as advancements in technology have transformed various aspects of society, including the field of education. Bank (2021) alludes that in particular, the integration of ICT in physics education holds great potential for enhancing students' learning experiences and promoting their understanding of complex scientific concepts. Simon (2022) went on to suggests that over the past decade, there has been a significant increase in the use of ICT tools and resources in physics classrooms. These tools range from interactive simulations and virtual laboratories to educational software and online platforms. They offer students opportunities to explore abstract physics concepts through hands-on experimentation, visualizations, and simulations, thereby promoting a deeper understanding of the subject matter. Barker (2022) alludes that one prominent trend in ICT integration is the use of digital simulations and modeling software. These tools allow students to simulate and visualize physical phenomena, conduct virtual experiments, and analyze data in a controlled and interactive environment. Such simulations provide a bridge between theoretical concepts and real-world applications, enabling students to develop problem-solving skills and scientific inquiry abilities.

Sophie (2021) posits that physics education traditionally relies on theoretical instruction and hands-on experiments conducted in physical laboratories. While these methods are valuable, they can be limited in terms of accessibility, resources, and opportunities for experimentation. However, with the advent of ICT tools and resources, educators can overcome these limitations and provide students with interactive, engaging, and immersive learning experiences.

In the study of James (2019) in USA concludes that the traditional practices which were used in the teaching and learning of physics education was based on the use of the traditional materials which includes books, chalk boards and charts. Learners were exposed to these methods however, the challenges associated was the limitation of these resources. Howie (2022) went on to concur with the research finding as she concludes in California that physics education has been taught based on the use of textbooks, magazines, fliers and charts over the past decades.

Qwalani (2021) in his study in Britain noted that the current practices of physic education is the integration of the ICT tools. The increase in the use of the ICT has left physic education with no exception other than to be integrated in the ICT learning. Experiments are now done using the ICT tools and software which has transformed the teaching and learning of physics education. Smith (2022) also concurs with the research results as he studied the relationship between ICT and physical education in Canada. He concludes that current practices are that most of the physics teaching in these days schools uses ICT tools.

In the study by Opilo (2019) in Nigeria noted that there are challenges which are there in the integration of the ICT tools. He went on to note the emerging trend is the incorporation of online resources and platforms for accessing educational content. Open educational resources, online textbooks, and educational websites provide students with anytime, anywhere access to a vast array of physics-related materials. This digital accessibility promotes self-paced learning, collaborative exploration, and personalized instruction. The responses from the interviews reflected, the growing demand for 21st-century skills, such as critical thinking, collaboration, and digital literacy, has pushed educators to embrace ICT as a means to foster these skills. By incorporating technology into physics education, students can develop digital literacy, information literacy, and technological competency, which are essential for their future academic and professional endeavours.

Phiri (2018) in his study in Malawi reflected that there are significant challenge is the need for teachers to develop the necessary pedagogical skills and technological competencies to effectively integrate ICT tools into their teaching practice. Teachers must be proficient in selecting appropriate digital resources, designing engaging activities, and managing technology-infused classrooms.

Banda (2020) in his study in Zambia has reflected that the digital divide, which refers to the unequal access to technology and internet connectivity among students. Ensuring equitable access to ICT tools and resources is crucial to prevent further disparities in learning opportunities. Additionally, concerns regarding the reliability, security, and quality of online resources need to be addressed to ensure their suitability for educational purposes.

According to Pedzisayi (2020) in his study in Mashonaland Central concludes that the integration of ICT is challenging as many schools in rural areas faces challenges in relation to the connection. The Network providers who are Econet, Netone and Telecel do not have coverage in some rural part of the areas. Mavhura (2021) noted that load shedding has been a challenge around Zimbabwe of which its major impact are in rural areas where schools in rural areas tend to have challenges to power on their laptops and computers which becomes the major challenge for the integration of ICT in physic learning.

It is against this background that the study is to examine the current practices, trends, and challenges related to the integration of ICT in physics education. By exploring successful implementations, emerging trends, and addressing the existing challenges, this study aims to provide insights and recommendations for educators, policymakers, and researchers to effectively integrate ICT in physics education. When these challenges are not addressed physics teachers will continue to use the traditional methods in the teaching and learning of physics of which this will ultimately affect the pass rate of physics. Ultimately, the goal is to enhance physics learning experiences, promote students' understanding of scientific concepts, and prepare them for a technology-driven future.

1.2 Statement of the problem

The integration of Information and Communication Technology (ICT) in physics education offers numerous opportunities to enhance students' learning experiences and improve their understanding of complex scientific concepts. However, there are several challenges which

are faced in the integration of ICT in physics education. These challenges has an effect of teacher morale which has an implication to cause an exodus of teachers to where 21st century skills are considered. Parents are not happy since their children will be half baked cakes as they lack contemporary skills of ICT. To the school, there is a continuous poor grades in physics. Hence the study sought to examine the current trends, practices and challenges which are faced in the integration of ICT in the teaching and learning of physics.

1.3 Objectives

The research study is going to be guided by the following research objectives:

- To examine the current practices of ICT integration in physics education.
- To identify emerging trends in ICT integration in physics education.
- To analyze the challenges and barriers to effective ICT integration in physics education.
- To explore strategies and best practices for overcoming challenges in ICT integration.

1.4 Research questions

The study sought to answer and be guided by the following research questions:

- What are the current practices of ICT integration in physics education?
- What are the emerging trends in ICT integration in physics education?
- What are the barriers and challenges which teachers face to effective ICT integration in physics education?
- In what way can challenges in ICT integration be reduced in physics education?

1.5 Significance of the study

Teachers

By exploring the current practices and trends in ICT integration, this study can provide insights into how technology can be effectively utilized to enhance physics education. The findings can inform educators about innovative instructional strategies, tools, and resources that can foster student engagement, improve conceptual understanding, and develop critical thinking skills.

Ministry of Primary and Secondary Education

The study aims to identify and address the challenges and barriers that hinder the effective integration of ICT in physics education. By understanding these challenges, policymakers and educators can develop strategies and initiatives to overcome them, ensuring that all students.

Universities and Colleges

The study recognizes the importance of teacher training and professional development in ICT integration. By identifying the gaps in teacher training and technological competence, the findings can inform the development of professional development programs that equip educators with the necessary skills and knowledge to effectively integrate ICT in their physics classrooms.

Education Policy Makers

The study acknowledges the digital divide and the unequal access to technology among students. By addressing issues of accessibility and equity, the findings can guide policymakers in developing initiatives to bridge the digital divide, ensuring that all students, regardless of their socio-economic background, have access to ICT tools and resources for physics education.

Research Literature

The study contributes to the existing body of research on ICT integration in education, specifically in the context of physics education. It provides a comprehensive analysis of current practices, emerging trends, challenges, and strategies, filling a gap in the literature and serving as a valuable resource for future research endeavors.

1.6 Limitation of the study

Time-The study's findings may be based on data collected within a specific timeframe, which may limit the representation of current practices and emerging trends. Given the rapidly evolving nature of technology and educational practices, the findings may not capture the most recent developments in ICT integration in physics education.

Self-reported Data-The study may rely on self-reported data, such as surveys or interviews, which are subject to respondent bias. Participants may provide socially desirable responses or may not accurately recall or represent their ICT integration practices. Measures will be taken

to maximize the validity and reliability of the data, but limitations inherent to self-reported data should be considered.

Focus on Physics Education- The study focuses specifically on ICT integration in physics education. While this provides valuable insights into this specific subject area, the findings may not be directly applicable to other disciplines or subject areas. The unique characteristics of physics education, such as the experimental nature of the subject, may introduce specific challenges and considerations that may not be fully explored in this study.

1.7 Delimitation of the study

The study has the geographical delimitation and theoretical limitation. The study will focus on four schools in Buhera District. The findings may not be representative of ICT integration practices in physics education on a global scale. The specific geographic scope will be clearly defined and stated in the study. More so, the study focus on specific ICT tools, software, or resources commonly used in physics education. While efforts will be made to capture a range of tools and resources, the study may not cover the entire spectrum of available ICT options. The selection of specific tools and resources will be based on their relevance and prevalence in the chosen context.

1.8 Organisation of the dissertation

Chapter one introduced the study with the background, statement of problem, purpose of the study, objectives of the study, research questions, significance and scope of the study and definition of key terms. The chapter two reviewed literature on the ICT integration, current practices, trends and challenges. It is guided by the research objectives. Chapter three dealt with the research methodology used in the study with the fourth chapter dealing with the data presentation and discussion. The final chapter, five, focused on the summary of findings, conclusion and recommendations.

1.9 Definition of terms

According to Banks (2020) information communication technology is an extensional term for information technology (IT) that stresses the role of unified communications and the

integration of telecommunications (telephone lines and wireless signals) and computers, as well as necessary enterprise software, middleware, storage and audio visual, that enable users to access, store, transmit, understand and manipulate information.

Mario (2021) defined physics as the study of the fundamental laws of nature and the interactions between matter and energy.

According to James (2019) a challenge is a difficult task or situation that requires significant effort, skill, or ingenuity to overcome or accomplish.

1.10 Summary of the chapter

In this chapter, the background and context of the study on the integration of Information and Communication Technology (ICT) in physics education are provided. The research objectives and questions are outlined, highlighting the significance of the study. The scope and limitations of the research are discussed, and an overview of the dissertation structure is presented. The next chapter is going to look at literature review.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter reviews the literature by other researchers. Literature review is a process that involves reviewing relevant literature to gain a broad background or understanding of information that is available related to the problem (Burns and Groove, 2017). This chapter gives an intuition into current practices, trends and challenges in the use of ICT in the teaching and learning of physics. The discussion will encompass global, regional, and local views as well as researches on the perceptions on the current practices, trends and challenges on the use of ICT in the teaching and learning of physics. Literature review being a summary of findings which works in the same effort to help identify and explain the phenomena under study at the same time measure what has been done towards the subject matter.

2.1 Theoretical framework

The integration of Information and Communication Technology (ICT) in physics education encompasses current practices, emerging trends, and challenges. A theoretical framework that can help guide the analysis of this topic is the Technological Pedagogical Content Knowledge (TPACK) framework. The TPACK framework, developed by Mishra and Koehler (2006), emphasizes the interplay between technology, pedagogy, and content knowledge.

The theory states the technological knowledge dimension of the TPACK framework refers to teachers' understanding of various ICT tools, software applications, and technological resources available for physics education. It encompasses knowledge of how to effectively use these technologies to enhance teaching and learning experiences in physics. This part is critical as the teachers are the driving force. Teachers understanding on the use of ICT gadgets means the implementation of the gadgets in the teaching and learning of physics.

In addition to the above pedagogical knowledge within the TPACK framework focuses on teachers' understanding of instructional strategies, teaching methods, and classroom management techniques. It involves knowledge of how to design and facilitate learning

experiences that promote student engagement, understanding, and skills development in physics. Therefore when teachers has a full understanding of the methodologies in the use of ICT gadgets this allows them to have a better knowledge and understanding of the ICT usage in the teaching and learning of physics. Banks (2021) alludes that pedagogical content knowledge integrates pedagogical knowledge and content knowledge. It represents teachers' understanding of how to effectively teach and present physics concepts to students. PCK involves identifying common misconceptions, designing appropriate instructional strategies, and selecting suitable examples and analogies to facilitate student understanding.

Furthermore Simone (2021) alludes that content knowledge refers to teachers' deep understanding of the subject matter, specifically in the context of physics education. It encompasses knowledge of fundamental physics concepts, principles, theories, and their applications. Content knowledge provides the foundation for effective teaching and learning experiences in physics. He went on to alludes that there is need to marry the content knowledge and the technological content knowledge. Technological content knowledge combines technological knowledge and content knowledge. TCK focuses on teachers' understanding of how technology can be used to represent and present physics content in meaningful ways. It involves selecting and utilizing ICT tools and resources that align with the content and enable effective learning experiences.

Victor (2021) alludes that technological pedagogical knowledge integrates technological knowledge and pedagogical knowledge. TPK refers to teachers' understanding of how to use technology to support and enhance pedagogical practices in physics education. It involves selecting appropriate ICT tools, designing technology-integrated lessons, and facilitating interactive and collaborative learning experiences. He went on to say that TPACK represents the integration of technological knowledge, pedagogical knowledge, and content knowledge. It encompasses the understanding of how technology, pedagogy, and content knowledge interact and influence each other in the context of physics education. TPACK emphasizes the need for teachers to effectively integrate ICT tools and resources in alignment with pedagogical goals and physics content.

By applying the TPACK framework to the analysis of the integration of ICT in physics education, one can examine the interplay between technology, pedagogy, and content

knowledge. It provides a comprehensive lens to understand the current practices, emerging trends, and challenges associated with ICT integration in physics education and highlights the importance of the interconnections between these knowledge domains.

2.2 Current practices in ICT integration

The integration of Information and Communication Technology (ICT) in physics education has brought about various current practices that aim to enhance teaching and learning experiences in the subject. In the study of Bank (2021) has reflected that ICT has revolutionalised the teaching and learning of physics. In his study in USA among five secondary schools has reflected that these secondary school are utilising ICT in the teaching and learning of science. School are utilising the simulation software. Physics teachers utilize simulation software to create virtual experiments and simulations that allow students to explore and interact with complex physics concepts. These software applications provide a hands-on experience where students can manipulate variables, observe outcomes, and gain a deeper understanding of physical phenomena. The research study also concurs with that of Vancliff (2020) who did his study among fourteen secondary schools. He did an analysis on the integration of ICT among science teachers. In his analysis he noted that physics teachers in Scotland has demonstrated high level of ICT integration. The current practice of ICT is that of data logging and analysis tools in these secondary schools. ICT tools such as sensors, probeware, and data logging devices enable students to collect real-time data during physics experiments. This data can then be imported into software applications for analysis, graphing, and interpretation. Students can develop skills in data analysis, graphing, and drawing conclusions based on the collected data.

Scot (2021) in his study in Bahamas has shown that education has been revolutionalised and has taken a different dimension. The system has taken a contemporary dimension in which teachers has moved from a traditional dimension of teaching using chalkboard and textbooks. The study he did was based on the analysis of the state of ICT integration in secondary schools in Bahamas. The study has observed that these schools are integrating ICT in the teaching of physics education as been reflected with the use of interactive whiteboards and projectors. Interactive whiteboards and projectors are commonly used in physics classrooms to display visual representations of physics concepts, equations, and graphs. These interactive tools allow

teachers to illustrate complex concepts effectively, and students can actively participate in problem-solving and concept development activities. These have assisted in demonstrating abstract concept in physics as it made teaching more interesting.

Additionally, ICT integration among the learners has been the emerging trend in these days among the teachers especially in physics teaching and learning. In Germany according to Vanphrah (2022) there are online resources and digital textbooks which has demonstrated the integration of ICT in physics education. Physics educators are increasingly incorporating online resources and digital textbooks into their teaching practices. These resources provide access to multimedia content, interactive simulations, video tutorials, and practice exercises. Students can engage with these resources independently and at their own pace. From the study which was done by Vanphrah has shown that all secondary schools in Germany has WIFI installation and learners are bringing tablets and laptop. Schools have their server which is accessed by all learners where physics pdf, experiments and video lessons are uploaded and downloaded by the learners.

Creswell (2021) alludes that in France there has been maximum utilisation of ICT in the teaching and learning of physics. In his study it has reflected that most of the secondary schools has developed the online collaboration and discussion platforms. Online platforms, such as discussion forums, learning management systems, and video conferencing tools, enable physics students to collaborate with their peers, engage in virtual group discussions, and receive feedback from teachers. These platforms foster communication, knowledge sharing, and collaborative problem-solving. Most of the secondary schools has started online discussions using Microsoft office, google meets and zoom in meetings. These have increase the utilisation of physic education into ICT.

Rancho (2020) alludes that virtual and augmented reality technologies are gaining popularity in physics education. These immersive technologies allow students to visualize and interact with three-dimensional models, complex systems, and abstract physics concepts. Virtual and augmented reality simulations provide a more engaging and interactive learning experience. He did his study in India and has shown that most of the secondary schools in urban areas are engaging in virtual and augmented reality technology in the teaching and learning of physics

education. This has brought in new dimensions and trends in the teaching and learning of physics education.

Farhan (2021) in his study analysing teaching and learning of physics concluded that in Indonesia there has been a shift to online physics laboratories (remote labs) are becoming more prevalent, particularly in distance learning or blended learning environments. These virtual labs allow students to conduct physics experiments remotely using online interfaces and real laboratory equipment. Students can manipulate variables, gather data, and analyze results as they would in traditional lab settings. Urban schools has created their online library where learners could access reading materials and can follow the new trends in the physic education.

James (2021) who did his study in Nigeria has reflected that rural schools in most of the parts of the country are still lagging behind in the use of ICT in teaching and learning of physics. These secondary schools are still using traditional methods in the teaching and learning of ICT. Most of these schools still rely on the use of textbook and use of apparatus in doing experience of which some of the apparatus are not in existence which then creates a gap in the learning. The study concurs with that of Opilo (2021) who did his study in Kenya. He did a study on accessing the current state of ICT integration in and has concluded that most of the secondary schools in the country are not utilising the use of ICT gadget in the teaching of physics. In his comparative analysis he has concluded that urban schools are engaging the use of ICT learning whilst the rural schools are still lagging behind on the use of ICT in physics.

Phiri (2021) reflected that most of the schools in Zambia are still in the traditional system in the use of the ICT in science learning. In Chifombo where he did his study the teachers uses textbooks and chalkboard as methodology in the teaching and learning of science. Most of the school infrastructure is still traditional which has no change in the use of ICT learning. The study also concurs with the study by Zinyemba (2019) in Zimbabwe as he did his study in Marange. He has concluded that schools in Marange district still uses the traditional methodology in lesson delivery in science teaching.

Mapuranga (2018) brought in a different trend in the teaching of physics. She has done a comparative analysis between public schools and private schools in Zimbabwe. She has concluded that most of the private schools in Zimbabwe has utilised ICT gadgets in the teaching and learning of ICT whilst public schools are still in the traditional ways in the teaching and learning of ICT. Pedzisai (2022) concluded that in Midlands schools especially boarding

schools the current practice is the use of ICT whilst rural and mine schools are still using the traditional method of lesson delivery in the teaching and learning of physics. It is against this background that the study sought to understand the current practice on the use of ICT in the teaching and learning of physics education.

2.3 Emerging trends in ICT integration in physics education.

Emerging trends in the integration of Information and Communication Technology (ICT) in physics education are constantly evolving as technology advances and new educational practices emerge. The study by Peters (2022) has reflected that the emerging trend in the teaching of physics in Britain is the virtual reality (VR) and augmented reality (AR). Virtual reality and augmented reality technologies are gaining traction in physics education. These immersive technologies provide students with realistic and interactive experiences to explore complex physics concepts. Virtual reality and augmented reality can be used to simulate physics experiments, visualize abstract concepts, and create virtual environments for hands-on learning.

Sophie (2023) concluded that the emerging trend in the teaching and learning of physics in USA is the use of gamification. Gamification involves incorporating game elements and mechanics into educational activities. In physics education, gamification can be used to create interactive and engaging learning experiences. Physics-based games, simulations, and quizzes with leader boards, badges, and rewards can motivate students to actively participate, apply physics principles, and solve problems. This has been seen to have a positive results towards teaching and learning of physics. Simon (2021) also reflected the new emerging trend in the teaching and learning of physics which is online collaboration and remote learning: The COVID-19 pandemic has accelerated the adoption of online collaboration tools and remote learning in physics education. Online platforms and video conferencing tools enable students to collaborate with peers, engage in virtual group discussions, and receive real-time feedback from teachers. Remote learning environments have expanded access to physics education and provided opportunities for flexible learning. In his study among the school in Italy has reflected that teachers and learners are mostly using the online platforms for the teaching and learning physics. Teachers and learners utilises virtual platforms such as google meet and Zoom meetings in the teaching and learning. These platforms has been of interests among learners of late.

Howie (2023) concluded that data science and analytics is also other emerging trend which is used in the teaching and learning of physics. With the increasing availability of data and the emphasis on data-driven decision making, data science and analytics are becoming relevant in physics education. Students can analyze real-world physics data sets, apply statistical methods, and use data visualization tools to gain insights and make connections between theoretical concepts and practical applications. More so learners are engaging in the use of artificial intelligence and machine learning in the learning of physics. Artificial intelligence and machine learning technologies have the potential to enhance physics education by personalizing learning experiences and providing intelligent tutoring systems. Adaptive learning platforms can analyze students' performance, identify areas of weakness, and provide customized learning pathways and feedback. Artificial intelligence-powered simulations can simulate complex physics phenomena and provide interactive guidance.

Additionally, David (2022) also reflected the new emerging trend in the teaching and learning of physics which is the internet of things. The internet of things refers to the interconnection of devices and objects through the internet. In physics education, the internet of things can be applied to collect and analyze real-time data from sensors and smart devices. Students can design and conduct physics experiments using internet of things technologies, enabling them to explore the relationship between physical phenomena and connected systems.

More over, according to White (2023) open educational resources is another emerging trend in the teaching and learning of physics. Open educational resources are freely available digital resources, including textbooks, videos, simulations, and interactive modules. OER provides educators and students with access to high-quality and up-to-date physics content. It promotes collaboration, sharing of resources, and customization of learning materials to suit diverse learner needs. In the study by white he has reflected that most of the secondary schools in Germany has commenced the use of the open distance learning to teach learners physics.

Harot (2022) alludes that robotics and physical computing has been also another emerging trend in the teaching and learning of physics. Robotics and physical computing allow students to apply physics principles in hands-on projects. Students can build and program robots, sensors, and actuators to explore physics concepts, such as motion, forces, and energy. These activities foster problem-solving skills and creativity while integrating technology and physics

education. It is against this background the researcher sought to understand the emerging trends in the teaching and learning of physics education.

2.4 Challenges and barriers to effective ICT integration in physics education.

While the integration of Information and Communication Technology (ICT) in physics education offers numerous benefits, there are also several challenges and barriers that need to be addressed for effective implementation. The study by Don (2022) in Australia has reflected that many schools in Australia has still having challenge in terms of infrastructure and access as main challenge to the implementation of ICT to the teaching and learning of physics education. Insufficient technological infrastructure, including limited access to computers, internet connectivity, and software resources, can impede the effective integration of ICT in physics education. Unequal access to ICT tools and resources may widen the digital divide and create disparities in learning opportunities.

Opilo (2019) has reflected that cost has affected the use of ICT in the teaching and learning of ICT in India. Most of the rural schools in India are poor and they have a challenge to access the ICT gadgets which includes laptops and WIFI installation hence for teachers to implement the use of the ICT gadget is a challenge to main of the schools in India. The cost associated with acquiring and maintaining ICT resources, including hardware, software, and licenses, can be a significant barrier for schools. Limited budgets may restrict the availability of up-to-date technologies and hinder the implementation of ICT in physics classrooms.

Daniel (2021) in his study in Romania has concluded that technological obsolescence is another challenge which implement the use of ICT in the teaching and learning of physics. Rapid advancements in technology can render ICT tools and resources obsolete quickly. Keeping up with the latest technologies and ensuring compatibility with existing infrastructure can be challenging for schools and teachers. The need for regular updates and replacements can strain limited resources and hinder the sustainability of ICT integration efforts. Therefore most of the schools can not keep updated with the recent developments on ICT integration. They are having challenge with the emerging trends hence cannot up to date with the current changes in the ICT usage.

Additionally, Bank (2021) in his study on the challenges faced by teachers in the use of ICT in teaching and learning of physic has reflected that of assessment and evaluation: Assessing student performance and understanding in an ICT-integrated physics classroom can present

challenges. Traditional assessment methods may not fully capture the skills and competencies developed through ICT integration, such as problem-solving, collaboration, and critical thinking. Developing appropriate assessment strategies and tools that align with ICT-integrated learning outcomes is essential. More so he concludes that integrating ICT in physics education requires students to possess digital literacy skills to navigate online resources, critically evaluate information, and effectively use digital tools. However, students may have varying levels of digital literacy, and there can be a skills gap between students and teachers. students from rural areas have a skill shortage which makes it difficult for them to master the use of ICT tools and to use in the teaching and learning of physics.

Opilo (2021) concludes that teachers in Kenya lacks professional skills in the teaching and learning using ICT tools. Most of the teachers who were interviewed during the study has reflected that they graduated from colleges and universities way back before the introduction of ICT module hence it is a challenge for most of the teachers to integrate ICT in the teaching and learning of physics. Effective integration of ICT in physics education requires teachers to possess the necessary technological skills and pedagogical knowledge. However, many teachers may lack adequate training and professional development opportunities to effectively integrate ICT tools into their teaching practices

Phiri (2019) in his study in Zambia ha reflected that time constrain is the major challenge which has affected the implementation of the use of ICT gadgets in the teaching and learning of physics using ICT. Teachers often face time constraints due to curriculum demands and limited instructional time. Integrating ICT effectively requires careful planning, preparation, and integration into the existing curriculum. The need to learn new technologies and adapt teaching methods may be perceived as an additional burden, leading to limited implementation of ICT in physics education.

Bones (2022) has reflected that most of the teachers in South Africa resist to change. Resistance to change can be a significant barrier to effective ICT integration in physics education. Some teachers, students, or administrators may resist incorporating new technologies due to concerns about the disruption of established teaching methods, lack of confidence in using technology, or skepticism about the benefits of ICT integration.

Mavhura (2022) has reflected that in Zimbabwe most of the rural areas do not have electricity hence for the installation of wifi is a challenge since there is shortage of power network to support the use of network. More so to those schools with electricity there is high load shedding

in Zimbabwe which then affect the use of ICT hence the use of the ICT in the teaching of physics is a challenge. Maponga concurs with the research findings as he concludes that most of the rural schools do not have financial resources to purchase gadgets and maintain also gadgets needed in the teaching and learning of physics. More so rural learners do not have financial break through for them to access ICT gadgets which becomes the main challenge for most of the learners to use ICT gadgets in the learning of physics. It is therefore against this background that researcher sought to find out the challenges faced by teachers and learners in the use of ICT gadgets in the teaching and learning using physics.

2.5 Strategies and best practices for overcoming challenges in ICT integration.

According to Blunkrupt (2021) recommends that there is need for the gradual integration of the ICT in science so as to appreciate the ICT gadgets and tools in education. Introduce ICT tools and resources gradually to allow both teachers and students to become familiar with them. Start with simple and user-friendly technologies and gradually incorporate more advanced tools as confidence and skills develop. This approach helps to minimize resistance to change and promotes a smoother transition. More so Simon (2021) alludes that there is need of provision of technical support among the science teachers. He went on to suggest that there is need to ensure that that teachers and students have access to technical support when using ICT tools and resources. Schools should establish a helpdesk, provide documentation or user guides, and encourage peer support among teachers. Having reliable technical support available helps address technical issues promptly and reduces frustration.

Howie (2019) suggested that schools should establish collaboration among different stakeholders. The ministry of education has to establish collaboration among teachers, students, and other stakeholders to share ideas, experiences, and resources related to ICT integration. Establish professional learning communities, online forums, or social media groups where educators can exchange best practices, troubleshoot challenges, and learn from one another. He went on to suggest that the ministry has to take steps to address equity and access issues related to ICT integration. Ensure that all students have equal access to technology and internet connectivity, both at school and at home. Explore options for providing loaner devices, creating computer labs, or partnering with community organizations to bridge the digital divide.

Additionally Sophie (2022) alludes that teachers design learning experiences that actively engage students in using ICT tools for exploration, discovery, and problem-solving. Encourage student collaboration, inquiry-based activities, and project-based learning that utilize digital resources. This approach promotes student ownership of learning and enhances their motivation and interest in physics. She went on to suggest that the ministry of education should design assessment strategies that align with ICT-integrated learning outcomes. Incorporate a variety of assessment methods, such as online quizzes, multimedia presentations, or digital portfolios, to gauge student understanding and skills development. Provide timely and constructive feedback to guide students' progress and encourage reflection.

Samuel (2021) alludes that in Australia regularly evaluate the effectiveness of ICT integration in physics education through feedback, assessment data, and reflection. Teachers use this information to identify areas for improvement, make necessary adjustments, and refine their implementation strategies. They continuously seek feedback from students, teachers, and other stakeholders to inform decision-making process. He went on that the department of education stay abreast of emerging technologies, software applications, and digital resources relevant to physics education. Stay connected with professional organizations, attend conferences, and participate in professional development opportunities to stay updated on the latest trends, research, and best practices in ICT integration.

In the study by Maponga (2019) on the challenges on the use of ICT by physics teachers in Matabeleland recommends the professional development among the teachers. Teachers needs professional development through workshops on ICT usage in education as a methodology. There is also need to cascade it downwards from the head-office to the grass-root teacher. Teachers also needs in house workshop on usage of ICT to teach physics. The workshop should be spearheaded by ICT specialists as they teach teachers basic skills on the ICT to the learners.

Zinyemba (2021) also made recommendations that of rural electrification and wifi installations. The government of Zimbabwe should fast track its rural electrification program. The program has to be also in conjunction with solar electrification among rural school. All rural schools should be installed wifi that learners may grasp the advantage that of usage of internet services. When schools has internet services teachers can download notes, books, pdfs and video lessons in relation to physics which can be used by learners.

Dhliwayo (2021) in his study recommends governmental grants to support rural schools in Zimbabwe. He has noted that most of the rural school in Zimbabwe are financially struggling especially in his reference to Gokwe schools. He has recommended that government and nongovernmental organisation support the rural school with resources. He has also referenced presidential donation schemes in relation to laptops. The government has to donate laptops to be used by the school as this assists learners to be computer literate which will assists them in relation to integration of the skills in physics education.

In the study by Mutunami (2022) he has recommended teacher capacitation programs. He has applauded the government of Zimbabwe in conjunction with UNESCO of teacher capacitation programs. These programs has capacitated rural teachers as most of them got equipped with the trending methodologies in teaching and learning of physics. Additionally, the teacher capacitation programs were meant to support science and ICT programs hence these made teaching and learning of integrating ICT in science subjects feasible.

2.6 Summary

The chapter reviewed literature on the integration of ICT in the teaching and learning of science. The reviewed literature reflected the challenges which are faced by the teachers in the use of ICT tools in the teaching and learning of physics. Additionally, the researcher looked it from the global, then regional and lastly to the local. The reviewed literature has also recommendation on the challenges. The reviewed literature had not looked at the trends, practices and challenges faced by the teachers used in the use of ICT in teaching and learning of physics. This is the gap in which this study sought to fill looking at the case study of four secondary schools in Buhera. The next chapter will look at research methodology.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter focuses on the study's chosen research methodology. It begins by highlighting research design then research paradigm or research philosophy chosen for this particular study. It goes further to explain the research methodology and research strategy to be used. The composition of population sample and sample framework used for the study are outlined. It includes a detailed explanation of the data collection instruments that were used and how this data was analysed. At the end the ethical considerations for the study

3.2 Research design

The study used both quantitative and qualitative research design (Mixed). It involves collecting and analyzing both qualitative and quantitative data to provide a more comprehensive understanding of the research topic. The integration of qualitative and quantitative approaches allows researchers to explore different aspects of the research problem, gain deeper insights, and validate findings using multiple sources of evidence. According to (Kothari 2005), research design is the technical practice used to identify the research question, collect data and analyze the findings. The nature of the research problem and that the research questions embed mixed research questions therefore were paramount to select case study as being the most appropriate for the study. A case study is described the case as an empirical inquiry that investigates a contemporary phenomenon with its real life context (Perry, 2000). The main objectives of the mixed research design approach component of the study sought to understand the integration of ICT in physics education; current practices, trends and challenges. The case study involved a series of contacts and field trips to understand the nature of day-to-day roles, constraints and experiences in selected areas. The cross sectional study method was applied as this was a one-time study hence respondents were only interviewed and only answered questionnaires once meaning there will be no follow up interviews on the same interviews and answering of questionnaires.

3.2.1 Research paradigm/philosophy

This study was informed by pragmatism research philosophy. A pragmatism philosophy is middle of the road of the positivist and interpretivist research philosophies where the research borrows from both quantitative and qualitative techniques (Guba and Lincolin, 2018). Pragmatists believe that from an epistemological perspective at some stage during the research it will take an objective approach by not interacting with subjects, while at other stages it will be necessary to take a more subjective approach by interacting with research subjects to construct realities (Teddlie and Tashakkori, 2009). Here, a pragmatic approach allows researchers to be flexible enough to adopt the most practicable approach to address research questions. By doing this, there will be singular and multiple realities derived from the quantitative and qualitative research (Rorty, 1999; Creswell and Plano Clark, 2011). A pragmatic approach allows researchers to be flexible enough to adopt the most practicable approach to address research questions(Teddlie and Tashakkori, 2009). More so, a pragmatic approach would encourage researchers who use different methods in different paradigms to place an emphasis on shared meanings and pursuing joint action (Morgan, 2007). However, Hall (2013) has criticized pragmatism from a methodological point of view for not defining "what works" when it comes to research methods. He has argued that the value of research methods cannot be assessed before the research is completed.

3.2.2 Research methodology

The researcher has used mixed research approach. According to Croswel (2020) a mixed research study is a research design that combines qualitative and quantitative methods within a single study. It involves collecting and analyzing both qualitative and quantitative data to provide a more comprehensive understanding of the research topic. The integration of qualitative and quantitative approaches allows researchers to explore different aspects of the research problem, gain deeper insights, and validate findings using multiple sources of evidence. The integration of qualitative and quantitative data allows researchers to triangulate the findings, comparing and contrasting different sources of evidence. This helps establish credibility and increases confidence in the research results. Qualitative and quantitative methods offer different perspectives on the research problem. Qualitative data can help generate hypotheses or explore underlying mechanisms, while quantitative data can test

hypotheses and provide statistical evidence. Therefore mixed research studies can provide practical implications by bridging the gap between theory and practice. The qualitative component can help identify contextual factors and inform the development of interventions, while the quantitative component can measure the effectiveness or impact of those interventions.

3.2.3 Research strategy

The researcher took a qualitative case study research strategy. According to Simon (2020) a qualitative case study is a research method that focuses on the in-depth exploration and analysis of a specific case or cases within a particular context. It is a qualitative research approach that aims to understand complex phenomena, processes, or experiences by examining them within their real-life settings. Qualitative case studies provide rich, detailed descriptions and insights into the case under investigation. Qualitative case studies are well-suited for investigating complex and multifaceted phenomena that require an in-depth exploration to understand their intricacies. They allow for the exploration of multiple perspectives, capturing the viewpoints and experiences of various stakeholders involved in the case. However, qualitative case studies have some limitations as well. They often involve a small sample size, which limits the generalizability of the findings. Additionally, the subjective interpretation of data by researchers introduces the potential for bias.

3.3 Research methods

This section of the chapter covers components of the research study that consists of the research population, research sample, data collection procedures, participants selection, and data analysis. Research methods entails how exactly the research will be undertaken hence they determine how the research area and sample will be defined, the research design deployed, the nature of researcher participants interactions as well as data handling, processing and analysis. This component of the research is arguably considered the epitome of an academic research study.

3.3.1 Population and sampling

Population is a complete set of elements (persons or objects) that possess some common characteristic defined by the sampling criteria established by the researcher (Tripathi, 2015).

The population for the study entailed of physics teachers from four secondary schools in Buhera District. Key informant was selected from the District official science schools inspector. Physics teachers provided insights into current practices, trends and challenges they face in the integration of ICT in teaching and learning of physics. Science schools inspectors had a strong and direct insight into the current practices, trends and challenges which teachers face in the integration of ICT in physics teaching and learning.

The sampling framework used in this research was purposive sampling and non-probability procedure. (Patton 2001)) Defined sampling as a non-random method of sampling where the researcher selects information rich cases for in-depth study. Since it was not necessary to collect data from every teacher, the researcher selected for respondents who were able to provide with the important information. The respondents were chosen based on having the characteristics which enabled detailed exploration, examination and understanding of central themes of the experiences of physics teachers which the researcher wishes to investigate. . In this study, a purposive sample was selected since qualitative samples tend to be purposive rather than random because the universe was more limited and that much qualitative research examines single case, with some phenomenon embedded in a single social setting. According to (Powell 1997), under purposive sampling, people or other units were chosen for a particular purpose implying the use of judgment on the part of the researcher. For the qualitative research component, this was the situation for this study with a focus on four secondary schools in Buhera district. A purposive sampling has been used to select ten physics teachers in the district and one schools inspector. The researcher will interview two teachers and one schools inspector whilst the eight teachers will answer the questionnaire.

3.3.2 Data collection methods/instruments

Research methods are the strategies processes or techniques used in collecting of data or evidence for analysis so as to unravel new information or to better understand a phenomenon. This research utilized in depth interviews and questionnaires to understand the current practices, trends and challenges which physics teachers face in the integration of ICT in the teaching and learning of physics. This multi-method approach to data collection was part of the data overall approach to improving the quality and validity of case data through triangulation (Easter by-Smith et.al. 2008; Saunders et.al. 2009). More so the methods were complementary to each other and where possible, they were used in cycle in order to give an

in-depth understanding of case under study. In this study the researcher used in-depth interviews and questionnaires.

In-depth interviews are defined as personal interview that are unstructured and uses extensive probing to get a single respondent to speak freely as well as express detailed beliefs, feelings and perceptions on a given topic (Webb 2015: 121). Three interviews were conducted by the researcher. The researcher interview two physics teachers and one schools inspector. In-depth interviews allow researchers to obtain detailed and comprehensive data about participants' perspectives, experiences, beliefs, and attitudes. The open-ended nature of the interviews encourages participants to provide in-depth responses, enabling researchers to gain a deep understanding of the topic of interest.

Questionnaires are a research tool commonly used in quantitative and qualitative research to collect data from a large number of participants in a standardized and structured manner. They typically consist of a series of questions that participants complete either in a written format (paper questionnaires) or electronically (online surveys). For the purpose of this study the researcher has used open ended questions and close questions to have a better understanding on the trends, practices and challenges on the integration of ICT in physics learning. The questionnaire is divided based on research objectives. The first section will look at the demographic data of the respondents. The advantage of using the questionnaires is that it allow researchers to collect data from a large number of participants efficiently. They can be distributed to a wide audience, and participants can complete them at their convenience, minimizing the need for direct interaction between researchers and participants. Participants can choose to remain anonymous when completing questionnaires, which may encourage them to provide honest and candid responses, particularly for sensitive or personal topics. Questionnaires also offer a level of privacy as participants can complete them in their own time and space.

3.3.3 Data analysis methods/instruments

The quantitative data collected was analysed using statistical software and descriptive statistical methods such as tables and percentages (Waigama, 2008) was used. Qualitative data were interpreted and explained against the relevant research questions. This was done using

content and thematic analysis. Qualitative content analysis is one of the several qualitative methods currently available for analyzing data and interpreting its meaning (Schreier, 2012). Thematic analysis is a method for analyzing qualitative data that entails searching across a data set to identify, analyze, and report repeated patterns (Braun and Clarke, 2006).

3.4 Reliability and validity

Questionnaire was pilot-tested in order to unearth irregularities and vagueness in the questionnaire statements. The questionnaire was given to four teachers from different schools. The convenient sampling technique was utilized to select respondents for this exercise (Bhattacherjee, 2012). Bhattacherjee, (2012) gives the following information on pilot studies when he mentioned that, always pre-test your questionnaire, at least using a convenience sample, before administering it to respondents in a field setting. Such pretesting uncovered ambiguity, lack of clarity, or biases in question wording, which should be eliminated before administering to the intended sample. Comparative analysis of responses from the different schools was done as assurance of validity since there is given similarities amongst them. Mason, (2004) refers to validity as ensuring that you are observing, identifying or measuring what you say you are. The researcher's prior knowledge of the subject under research and secondary data were used to assess the validity of data provided by the respondents.

Reliability

A pre- test was conducted to ensure reliability on quantitative research phase. According to Saunders et al, (2003) reliability refers to the degree to which data collection tools will yield the same results when repeated. The pre-testing of the questionnaire was meant to ensure that the questions were clear and easy to respond.

Thorough examination of primary data was done to ensure reliability in the qualitative research phase. The consistency of data will be achieved when the steps of the research are verified through examination of such items as raw data, data reduction products, and process notes (Campbell, 1996). To ensure reliability in qualitative research, examination of trustworthiness is crucial. Merriam (2018) cautions researchers that a debate is raging because the constructs of reliability and validity are quantitative and positivist, and not necessarily that applicable to qualitative research (p. 199). Assessing the accuracy of qualitative findings is not easy.

However, there are several possible strategies and criteria that can be used to enhance the trustworthiness of qualitative research findings.

3.5 Ethical issues

Ethics are moral guidelines which guide the researcher when conducting a research. Research ethics educate and monitor the researcher to ensure a high ethical standard. Research ethics guide the researcher to conduct and report the research results without any deception or intention to harm the participants (Farrimond, 2012). The research observed the following four tenants of research ethics.

Confidentiality and Professional Conduct

This means protecting confidential communications for example, the researcher had a research letter which he took from BUSE and has introduced the researcher as a student at the university and has guaranteed the participants that the research is typically on academic purposes. The preamble of the questionnaire states that the research is only for academic purposes. The data was analysed and published as processed data, without mentioning names of participants, no videos and audios to be used.

Informed Consent

Informed consent is the cornerstone of ethical research (Denzin and Lincoln, 2011). Participants were fully informed on the use of the data and the dangers or consequences, if any. Participants agreed to take part in the research and signed as a sign of consent. To fully respect this, the researcher asked for the consent of the participants through asking them to sign a document explaining the ethics guiding the research.

Protection from Harm

The researcher should minimize potential risks and harm to the participants. Risk and harm should be minimized, but benefits should be maximized. Protection of vulnerable groups is also a must in research. Fortunately, the nature of the research does not expose participants to any physical harm. However, because state organisation are very sensitive in terms of data protection laws, the employees should be protected in terms of their job security. The researcher seek written permission from the Ministry of Primary and Secondary Education, PED and DSI office when collecting data.

Right to Privacy

Informed consent also means that a person has a right to privacy. Privacy means has a control over who can access them. Participants should not be forced to reveal information especially about themselves or their personal life, unless they agree to do so (Held, 2005). It is also

imperative that the research topic meet ethical standards, that is, it is morally accepted to carry out the research.

3.6 Chapter summary

This chapter focused on highlighting the study's chosen study methodology encompassing a qualitative data collection approach. The chapter listed various attributes relating to the study including sampling strategy, data collection techniques as well as the data analysis strategy chosen for the study. The next chapter highlights the presentation and analysis of data from the study, done in terms of the study's stated research objectives.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSION

4.0 Introduction

The chapter looked at the data presentation, analysis and discussion. The data presented were based on the research objectives. The chapter presented information on the integration of ICT in physics education looking at the current practices, trends and challenges. The first part of the chapter looked at the demographic data and the next sections looked at the data according to research objectives.

4.1 Response rate

According to Cress (2019) response rate was the rate of completion or rate of return, is the number of people who answered interview and respond to the questionnaire divided by the number of people in the sample. The response rate in this study was 100 %. The researcher managed to get in conduct with all the sampled people. The researcher managed to reach out all the participants since the researcher had the chance to reach out the participants as he did a hand delivery of the questionnaires and also made appointments with the participants on the interview. The table and bar graph below reflects the response rate of the respondents.

Table 4.1 Response rate

	Possible	Percentage	Actual	Percentage
Teachers	10	100	10	100
Schools Inspector	1	100	1	100
School Head	1	100	1	100

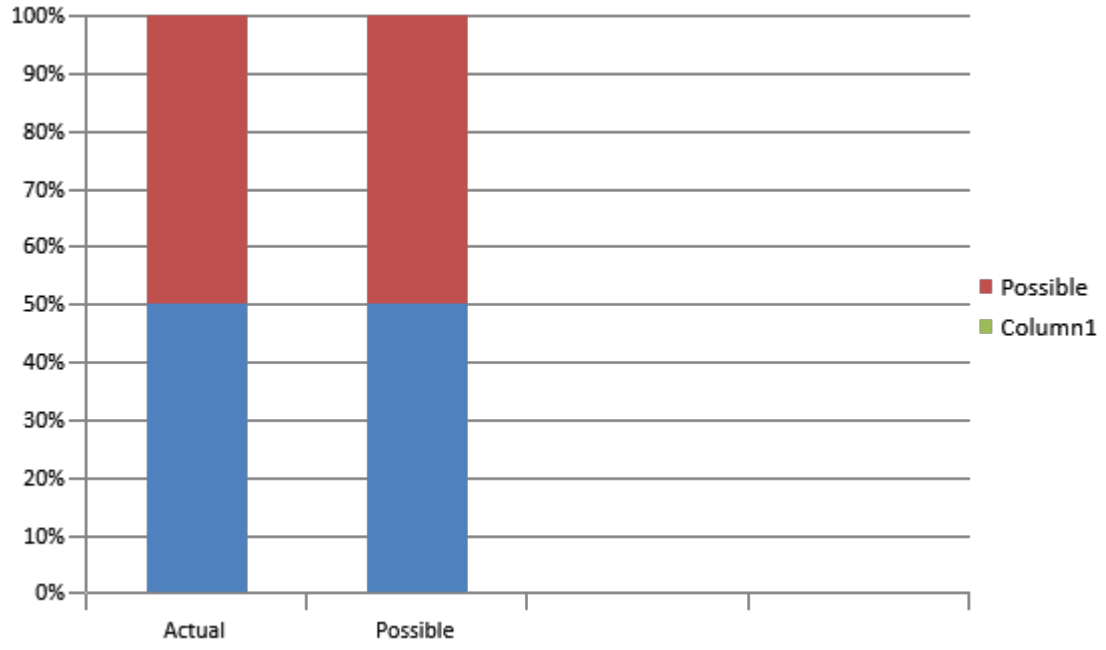

Fig 4.1 Distribution of teacher's response rate

N=12

The table and graph revealed that the response rate was high. Twelve out of twelve teachers responded to the questionnaires. This implies that all the teachers, schools inspector and school head answered the questionnaire. The researcher had one hundred percent response rate. The researcher manages to get in touch with every teacher, schools inspector and school head.

4.1.1 Demographic data

The researcher was also concerned with demographic data to know teacher gender, educational level and age and experience in the field. The table and bar graphs below reflects on the demographics characteristics of the respondents.

Table 4.2 Respondents by Current position

Position	Total Number
Teachers	10
Schools Inspector	1
School heads	1

The table reviewed that out of the twelve participates ten of them were class room teacher, one of them was the schools inspector and one was the school head. The researcher also went on to look at the gender status of the response. The data reviewed that there are many female teachers in the education sector.

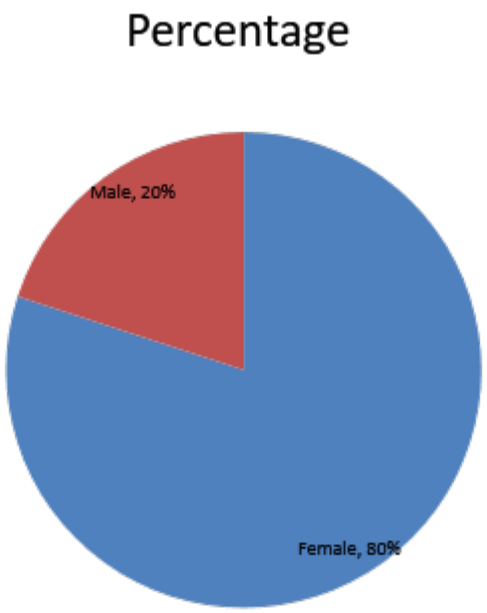

Fig 4.2 respondents by sex

The pie chart revealed that that there is twenty percent of male population who has participated in the study and eighty percent is female population. The reason behind maybe due to men who has left the ministry and went to other greener pastures. Another reason maybe because of the socialization of children from birth. Women are socialized to care as they play with babies hence the love of the education profession where there are children to take care of.

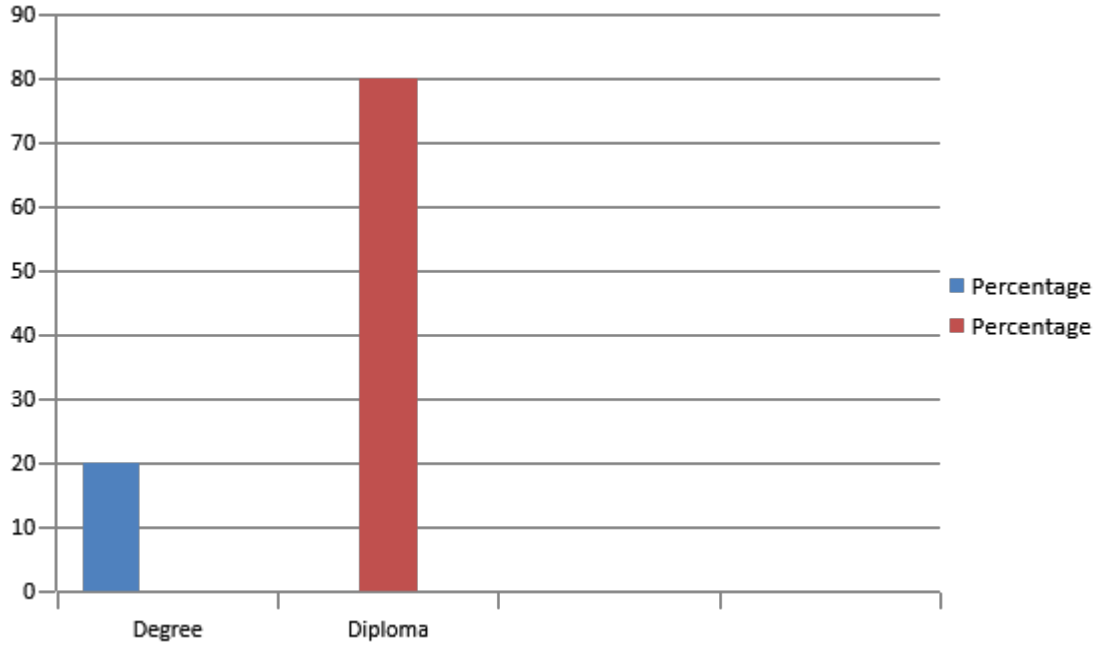

Fig 4.3 Education level

The graph reveals that twenty percent of the subjects who were interviewed had degrees whilst the eighty percent of them had diploma in education. It has been revealed that there are qualified teachers in education. There is no temporary or paraprofessional teacher in the field. However, it has been noted with sad consequences that science education field has limited number of teachers with degrees.

4.2 Current practices of ICT integration in physics education.

The first objective of the study was to look at the current practices of ICT integration in physics education. The researcher looked at how current practices of ICT integration by physics teachers. The table reflects on the responses of teachers on current practices of ICT integration. The questionnaire looked if current teachers are integrating ICT when teaching learners physics.

Table 4.2 Responses on the question: Current practices of ICT integration

	Positive	Negative	Grand Total
Teachers are empowered to use ICT in teaching and learning of physics	3	7	10
Total	3	3	

The table has revealed that seven teachers out of the ten teachers had reflected that they are not integrating ICT in the teaching and learning of physics in their schools. Three out of the ten has reflected that they use ICT gadgets in the teaching and learning of physics in their schools.

The researcher went on to probe on to the current practices on the use of ICT in the teaching and learning of physics by teachers. The researcher has interviewed the science schools inspector who has reflected that:

Science Schools Inspector: “the world has turned digital and no way out the world of 21st century requires the use of ICT gadgets. Physics like any other subject has to integrate ICT and artificial intelligence for the benefit of the learner. However, it is with great regret that our current physics teachers did not integrate ICT gadgets in the delivery of lessons. The teachers are still in their traditional platforms in teaching and learning of ICT”

The sentiments by the science schools inspector also concurs with the interview responses of the school had on the current practices by teachers in integration of ICT in physics teaching and learning. The responses has reflected that:

School head: “education has transformed on a radical change and has reflected so much change in relation to the way it has operated when it comes to ICT integration. However, the today teachers in the systems lacks ICT skills in the teaching and learning of physics which has left the gap to integrate ICT learning. However, a notable change is coming in place especially with the recruitment of new teachers in the system who are recent graduates from colleges and universities as they have been certified with ICT skills”

The researcher from the questionnaire responses and interview responses of science schools inspector and school head has reflected that there is a gap in the integration of ICT in the teaching and learning of physics. The researcher also concludes that the study has reflected that there is low practice of ICT integration in physics teaching and learning by teachers. The table and the pie chart below reflects the responses of teachers on various ICT tools and technologies used in physics education.

Table 4.3 Responses on the various ICT tools and technologies used in physics education

	SA	A	Neutral	DA	SD
Schools uses ICT gadgets in the teaching of physics	2	1	0	6	1

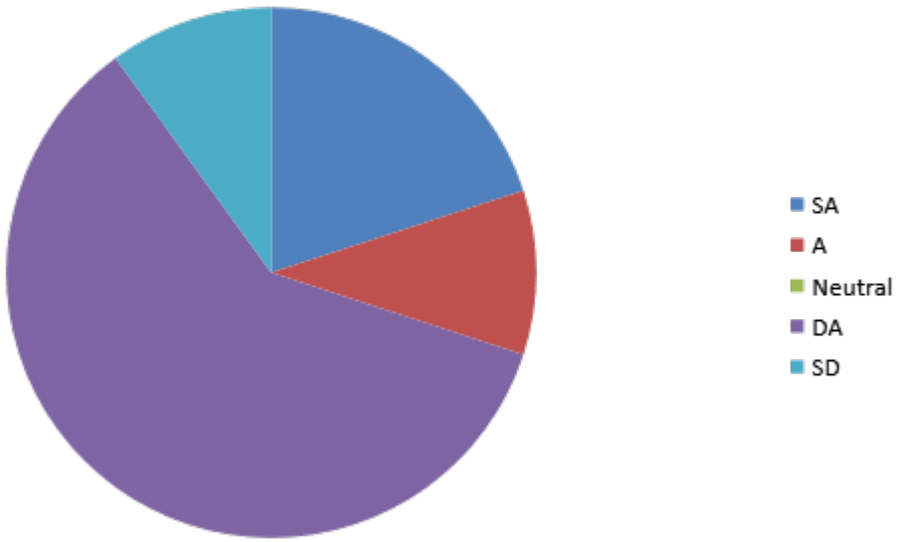

Fig 4.4 Responses on the various ICT tools and technologies used in physics education

The table and pie chart has reflected that six out of ten disagree that physics teachers uses ICT gadgets in the teaching and learning. One out of ten strongly disagree that physics teachers uses ICT in the teaching and learning of ICT. Two out of ten strong agree that physics teachers

uses ICT gadgets in the teaching and learning of physics whilst one has agreed that physics teachers uses ICT gadgets in the teaching and learning of physics. The researcher went on to complement the responses by the teachers from the questionnaire and has interviewed the science schools inspector. The science schools inspector has reflected that:

Science Schools Inspector: "most the schools in the district which has the physics curriculum do not engage the use of ICT gadgets. However, resourceful schools are engaging the use of ICT gadgets as these schools can purchase laptops, projectors and desk tops machines"

The responses by the schools inspector also concurs with the responses by the school head who has reflected that:

School head: " our schools are not financially stable and are not resourceful yet these schools fails to purchase any ICT gadget. Therefore despite willing to integrate ICT schools has a challenge that of ICT gadget integration as they are financial crippled"

From the responses the researcher concludes that schools do not have ICT gadgets which can be used by teachers in the ICT integration. Most of the schools has reflected that they do not have the gadgets which can be used. It is against this backdrop that there is low current practices of ICT integration in school in physics teaching.

4.3 Emerging trends in ICT integration in physics education.

The second objective of the study was to look at the emerging trends in ICT integration in physics teaching. The researcher looked at the trends which had took place in physics teaching and learning in relation to the ICT integration. This can be reflected on the table and hart below on teacher's usage of internet in physics learning and teaching. The teachers answered the questionnaire.

Table 4.4 Responses on the question on teacher's usage on internet in physics learning and teaching.

	SA	A	Neutral	DA	SDA
Teachers uses internet in teaching and learning of physics	2	1	0	7	0

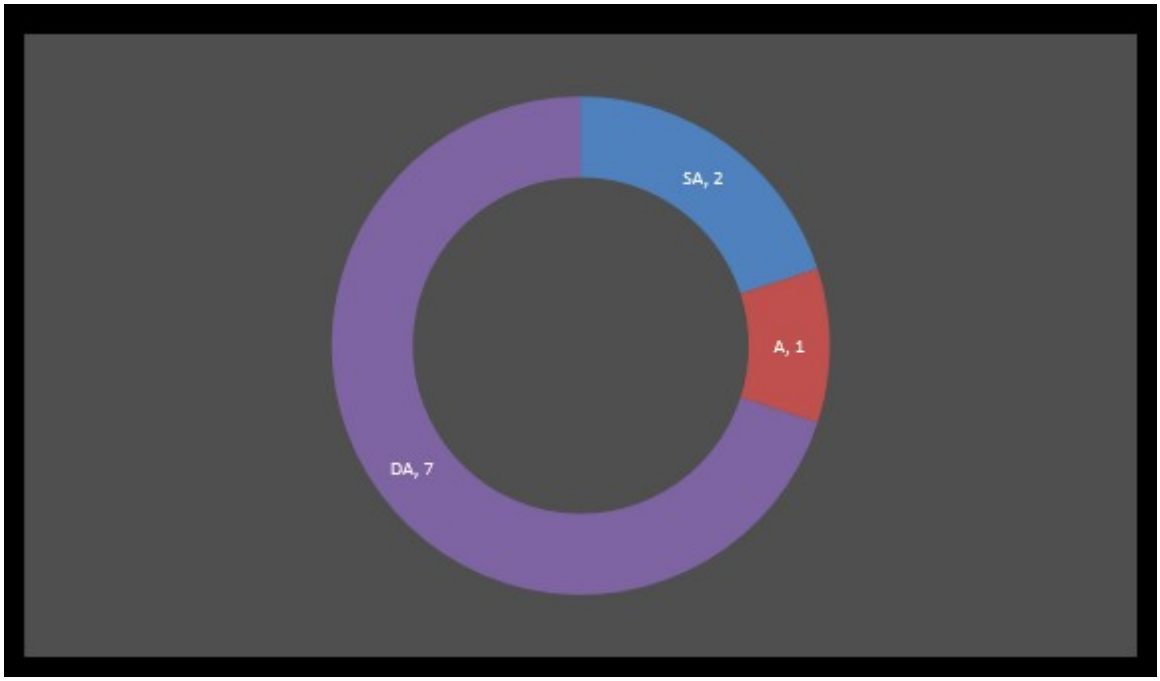

Fig 4.5 Responses on the question on teacher's usage on internet in physics learning and teaching.

N=10

The table and fig has reflected that out of ten teacher seven disagree that teachers uses the internet in the teaching of physics. One teacher out of the ten agree that teachers uses the internet in the teaching of physics and two teachers out of the ten strongly agree that teaches uses internet in the teaching of physics. The researcher went on to compliment the results from the questionnaire through interviews. The interviews results from the science schools inspector has reflected that:

Science Schools Inspector: " most of the today teachers are still using traditional method such as the use of the textbook, use of laboratory experiments and heavily relies on teacher notes of which the education has transformed as it incorporates the usage of ICT of which it is not the case. However, the Ministry of primary and secondary education has made a decree on the integration of ICT in the teaching and learning. This is the emerging trend in the teaching and learning of physics"

The interview responses by the schools inspector also concurs with the interview responses by the school head who has reflected that:

School head: " the today way of teaching is the usage of contemporary methods which includes the usage of ICT gadgets, artificial intelligence and also cloud based learning platforms. This is the today teaching and learning however, though this is the emerging trend schools and teachers still lag behind in the teaching and learning of ICT integration as most physics teachers still uses the traditional approaches and resources in the teaching and learning of physics"

The researcher from the above responses concludes that there is a shift from traditional approaches to the integration of ICT in the teaching and learning of physics. However, teachers still lag behind in the use of ICT in the teaching and learning of physics.

4.4 Challenges and barriers to effective ICT integration in physics education.

The third objectives of the study was to look at the challenges which are faced by physics teachers in the integration of ICT in the teaching of physics. The questionnaire has asked teachers on what are the challenges which they face in relation to integration of ICT. The table and graph below reflect the challenges faced by the teachers in the integration of ICT teaching and learning. The teachers has reflected that:

Table 4.5 Responses on challenges faced by teachers in the integration of ICT teaching and learning

Responses	Positive	Negative
Lack of teacher skill	9	1
Infrastructure limitations	8	2
Technological limitation	7	3
School culture	8	2

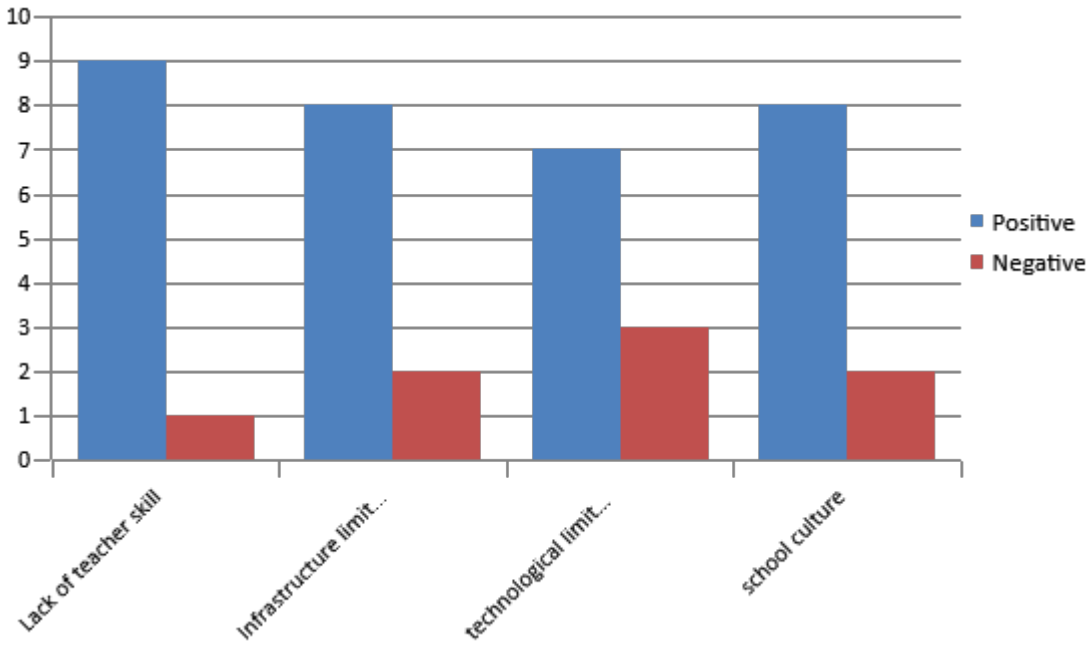

Fig 4.6 Responses on challenges faced by teachers in the integration of ICT teaching and learning

The table and graph above shows the challenges which teachers faces in the use of ICT in the teaching and learning of physics. The teacher responses has reflected that out of the ten teachers

nine has showed that lack of ICT skills is the main challenge which has affected the implementation of ICT usage in the teaching of physics. Teachers lacks confidence in the use of ICT gadgets. Lack of confidence and competence among teachers in using technology, leading to hesitation or resistance to adopting new tools and approaches. Eight out of ten teachers has reflected that the challenge which they face is that of infrastructure limitation. The teacher has reflected that most of the school infrastructure are outdated to support ICT gadgets which can be used in the teaching and learning of physics. Seven out of ten has reflected that they face technological limitation. ICT is an ongoing technological area which software evolve much and mainly schools faces challenge to buy software which can be used in models and simulation which can be used in ICT teaching and learning. Eight out of ten has reflected that school culture is the main challenge which affect the integration of ICT in physics learning. The resistance to change that is the need to remain in the traditional approach has affected the integration of ICT in the teaching and learning of physics in schools.

The questionnaire responses concurs with the interview responses of the schools inspector who has reflected that:

Schools inspector: “One of the main challenge faced by teachers is insufficient training and professional development for teachers to effectively integrate ICT into their physics instruction. More so, limited understanding of how to design and implement technology-enhanced learning activities that align with the learning objectives and pedagogy of physics education.”

The researcher went on to probe on the challenges which are faced by teachers in the use of ICT in teaching and learning of physics. The researcher went on to ask questions to the school head who has reflected that:

School head: “Outdated or inadequate technology infrastructure, including insufficient bandwidth, unreliable power supply, and lack of technical support are the main challenge which teachers faces. Zimbabwe is faced with unreliable power supply hence despite the efforts by the school to use ICT gadgets power outrages affects the implementation of ICT gadgets usage in the teaching and learning of physics”

The responses above, the researcher can conclude that teachers faces challenges in the usage of ICT gadgets. Teachers has reflected that they faces the challenge that of integration of ICT gadgets in the teaching and learning of ICT in education. Challenges which teachers faces ranges from lack of professional skills, school culture, infrastructure limitation and technological limitation

4.5 Strategies and best practices for overcoming challenges in ICT integration

The forth objectives of the study was to look at the strategies and best practices for overcoming challenges in ICT integration. This can be reflected by the table and pie chart below on the responses on strategies to overcome challenges on the implementation of ICT in physics learning. The questionnaire has a section which had a questions in relation to the strategies which can be implemented and the responses of the teachers has reflected that:

Table 4.6 Responses on question on strategies to overcomes challenges on the implementation of ICT in physics learning

	Yes	NO
Improve access and infrastructure	8	2

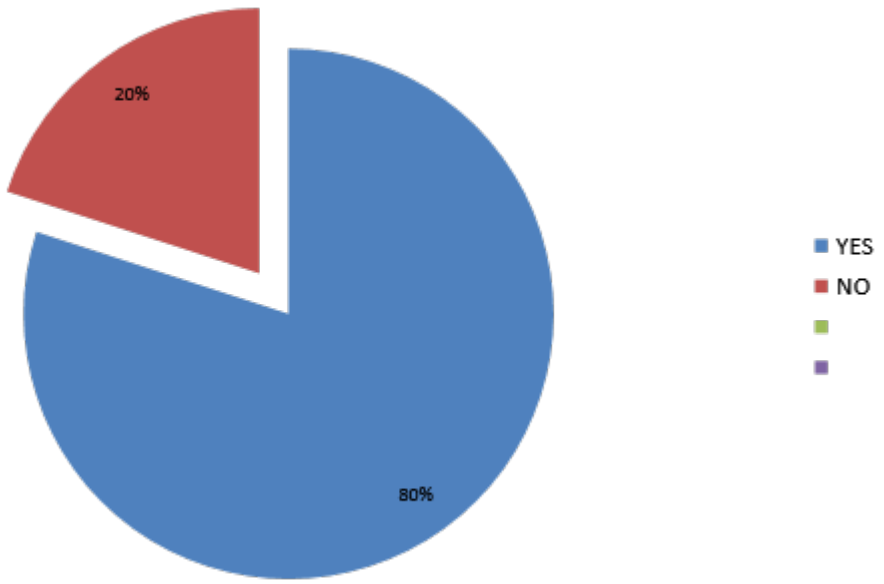

Fig 4.7 Responses on question on strategies to overcomes challenges on the implementation of ICT in physics learning

The table and pie chart above revealed that teachers suggested that there is need for the prioritization of infrastructure development as a way to improve the integration of ICT in teaching and learning of physics. School heads should prioritize the allocation of funding and resources to upgrade and maintain technology infrastructure, including hardware, software, and internet connectivity. The responses by the teachers also concurs with the interview responses by the schools inspector which has reflected that

School inspector: " Schools should implement initiatives to provide equitable access to digital devices and resources, such as implementing 1-to-1 computing programs or establishing technology-lending schemes."

The responses by the schools inspector also concurs with the responses by the school head who has reflected that:

School head : “ the is need for the transformation of the school infrastructure that is include the installation of WIFI so as teachers can use the internet in the teaching and learning of physics.

The researcher concludes that there is need for the integration of ICT gadgets in the teaching and learning of physics. Schools should transform its infrastructure to allow for safe landing of ICT integration in physics teaching and learning. The table below reflects the ways to eliminate challenges faced by teachers in ICT integration in physics learning.

Table 4.7 Responses on way to eliminate challenges faced by teachers in ICT integration in physics leaning

	YES	NO
Enhancing teacher preparedness	9	1
Purchasing of ICT resources	9	1
Capacitation programs	10	0
Maintenance programs	8	2

The table above reflected the responses by the teachers. Out of ten teachers nine has reflected that is need for enhancement of teacher preparedness in relation to the usage of ICT gadgets. Nine out of ten teachers has reflected that schools should purchase ICT gadgets which includes laptops and other crucial gadget. In terms of teacher capacitation in ICT programs all teachers unanimously agree. Eight of ten reflected that there is need for the maintenance programs in relation to ICT integration. Most of the teachers has reflected gadgets requires maintenance of which most of teachers do not have knowledge on hardware gadgets maintenance.

The questionnaire responses also concurs with the interview responses from the science schools inspector who has reflected that:

Science Schools Inspector: “There is need for teacher capacitation programs so as teachers can be equipped with ICT skills. Teachers should have the skills in relation to the integration of ICT gadgets. In house training programs in relation to ICT should be prioritised in schools”

The researcher went on to probe and asked the school head on the strategies which can be used by the teachers so as to enhance the effective use of ICT gadgets in the teaching and learning of ICT. The school head has reflected that:

School head: “there is need for ongoing training and support for teachers, including workshops, coaching, and mentorship, to help them effectively incorporate technology into their physics lessons.”

The researcher concludes that there is need for teacher capacitation and training programs so as to spear head the integration of ICT in the teaching and learning of physics. There is need for the in house workshops in relation to ICT so as every teacher be equipped with ICT skills.

4.6 Discussion

4.6.1 Current practices of ICT integration in physics teaching and learning

The first objective of the study was to look at the current practices of the integration of ICT in the teaching of physics. The research has reflected that there is low integration of ICT in the teaching and learning of physics. Teachers are still using the traditional approaches in the teaching and learning of physics. The research finding also concurs with research finding by Opilo (2019) who did his research in Tanzania and concludes that ICT integration in school is at low especially in rural areas where there is no resources to support the teaching and learning. The study also concurs with Kelvin (2021) who did his study in South Africa and has concluded that there is still a gap in South Africa in relation to the use of ICT gadgets in education as teachers still rely heavily on the usage of textbooks. The study by Moyo (2022) in Mberengwa

District concludes that rural schools still lag behind in the implementation of ICT in the teaching and learning process.

4.6.2 Emerging trends in the teaching and learning of physics

The second objective of the study looked at the emerging trends in the teaching and learning of physics. The study has noted that internet resource is the emerging trend which has occupied the teaching and learning of ICT. The study research finding also concurs with that of Smith (2021) who did his study in Nigeria and has concluded that the education system has transformed and has taken a new path that of going ICT. Maxwell (2019) concurs with the research finding who also did his research in Zambia and has concluded that ICT usage is the new normal and the new trend in education. Maponga (2021) who did his study among the private schools in Harare has concluded that schools has integrated the use of ICT in the teaching and learning.

4.6.3 Challenges faced by teachers in the integration of ICT in the teaching and learning of physics

The third objective of the study was to look at the challenges which teachers face in the implementation of ICT. The study has reflected that teachers faces a lot of challenges such as lack of skills and expertise, lack of teacher resources and lack of supportive infrastructure. The research finding concurs with the finding of Bank (2021) who did his research in Kenya as he has concluded that teachers in Kenya faces lack of ICT skills hence they can-not integrate ICT in the teaching and learning field. Buckle (2021) who did his study in Botswana concludes that teachers lack supportive resources such ICT gadgets for the full integration of ICT in the teaching field. Pedzisai (2020) who did his research among the rural learners in Chivi has concluded that lack of internet connectivity and lack of power in most rural schools has affected the integration of ICT in the teaching and learning process.

4.6.4 Strategies to reduce challenges face by teachers in the integration of ICT in the teaching and learning of physics.

The fourth objective of the study was to look at the strategies which can be used by teachers to reduce the challenges which teachers faces in the implementation of ICT in the teaching and

learning of physics. The research has recommended teacher capacitation programs. This research finding also concurs with that of Max (2019) who did his study in USA and has recommended teacher training and also University and colleges to align itself with the requirements of the 21st century needs that is the need for ICT integration in schools. More so Blark (2021) who did his study in Italy has suggested that teachers and schools needs to be equipped with resources for the full support of the teaching and learning of ICT gadgets. Mavhura (2019) who did his study in Matebeland South concludes that there is need for teacher capacitation programs as well as in-house workshops in relation to ICT skill integration in education.

4.7 Summary

The chapter presented analyzed data, made interpretations collected during the research and this all leads to the researcher to come up with conclusion, and recommendations which were looked upon in the following chapter.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Introduction

The previous chapter looked at the data presentation, analysis and discussion on the integration of ICT in teaching and learning of physics looking at the current practices, trends and challenges. . The chapter has looked at the gap in which this chapter gives chapter summary, conclusion and recommendations on the integration of ICT in teaching and learning of physics looking at the current practices, trends and challenges.

5.2 Summary of the study

The main purpose of the study was to look at the integration of the ICT in physics teaching and learning looking at the current practices, trends and challenges. Chapter one has looked at the background of the study which has looked at the funnel approach, that is from international, regional and then local and it is what drove the researcher into wanting to research the topic. The chapter has looked at the significance of the study, delimitation, limitation and definition of terms.

Chapter two has looked at the literature review of the study. The researcher has used the funnel approach where the researcher has looked the research at the international, regional and then local. The literature review was guided by the research objectives. The Technological Pedagogical Content Knowledge is the theoretical framework which has been used to guide the research study. The researcher looked at the current practices of ICT integration in the teaching of physics, the emerging trends in the teaching of physics, challenges faced by teachers in the integration and strategies which can be used by teachers in the integration of ICT in physics teaching.

Chapter three looked at the research methodology in which the researcher has used the triangulation research approach in which both qualitative and qualitative research method has been used in the study. The researcher has used the questionnaire and interview guide in the data collection. The researcher has used the simple random sampling technique in data gathering. The approach gives participants equal chances for them to be selected for the study. In undertaking the research the researcher observed confidentiality.

Chapter four looked at the data presentation, analysis and discussion as guided by the research objectives. The data was presented using graphs and tables and as well as verbatim sentiments. The chapter first section looked at the bio data of the participants. The other section looked at the current practices, the emerging trends, challenges and strategies which can be used to reduces challenges in ICT integration in teaching and learning of physics.

5.3 Conclusions

The research revealed that physics teachers has low integration of ICT in the teaching and learning of physics. The current practice in the teaching of physics is very low as most teachers still uses their traditional models in teaching and learning of physics.

The research also revealed that internet and ICT gadgets are the emerging trends which can be used in the teaching and learning of physics. However, teachers has reflected that they haven't yet updated with the current emerging trends in the teaching and learning of physics.

Teachers has reflected that they have challenges in the integration of ICT in the teaching and learning of physics. Teachers lacks ICT integration skills in the teaching and learning of ICT.

The study also concludes that there is need for teacher capacitation programs so as to equip teachers with essential ICT skills which they can integrate them in the teaching and learning.

5.4 Recommendations

The researcher made the following recommendations:

- Teachers should be provided with teacher capacitation programs such as those sponsored by Ministry of Primary and Secondary Education in conjunction with UNESCO.

- The teachers should be provided with in-house workshops and seminars so as to equip teachers with ICT skills meant to support for the integration of ICT in physics.
- Teachers' colleges and University should introduce ICT modules and be a mandatory for all students to graduate whilst having an ICT program.
- There is need for retrain of teachers who has been certified with education qualification way back before the introduction of ICT in colleges and universities
- Ministry of primary and secondary education should prioritise investments in upgrading and maintaining technology infrastructure, including hardware, software, and internet connectivity, to ensure equitable access for all students.
- Curriculum development unit should review and update the physics curriculum to identify opportunities for seamless integration of ICT-based activities, simulations, and virtual laboratories.
- Policy developers needs to implement robust maintenance and technical support systems to ensure the smooth operation and sustainability of the technology infrastructure.

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APPENDIX 1

QUESTIONNAIRE FOR ECD TEACHERS

I am Blessing Tatenda Chigumbate, a HBScEDPh at Bindura University of Science Education. I am carrying out a study on **"INTEGRATION OF ICT IN PHYSICS EDUCATION: CURRENT PRACTICES, TRENDS AND CHALLENGES. CASE STUDY OF 4 SECONDARY SCHOOLS IN BUHERA DISTRICT."**I kindly request you to complete this questionnaire as fully as you can. The information you provide will be treated with utmost confidentiality. Please do not write your name, address or phone numbers on this questionnaire.

SECTION A: BIO DATA

Indicate your answers by ticking in the most appropriate box (√), or by filling in your response in the space provided.

1. What is your sex? Male ☐ Female ☐

2. What is your age range?

30 years and below ☐ 31 - 40 years ☐ 41years and above ☐

3. What is your highest professional qualification?

Certificate/Diploma in Education ☐ Bachelor's Degree ☐ Masters Degree ☐

Other: (Specify)…….

SECTION B

4. What are the current practices in the integration of ICT in the teaching and learning of physics?

……..……

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……..……..

5. What strategies do you employ in the integration of ICT in the teaching and learning of physics?

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……
……
……

SECTION C

7. Indicate your level of agreement or disagreement to the statements below.

KEY: **S*A*** – *Strongly Agree;* ***A*** *– Agree;* ***N*** *– Neutral;* ***D*** *– Disagree;* ***SD*** *– Strongly Disagree*

FACTOR	RESPONSE				
The following are challenges faced by teachers in use of ICT in teaching and learning of physics	**SA**	**A**	**N**	**D**	**SD**
Lack of training and preparedness					
Lack of resources					
Classroom management strategies					
Community resistance					
Lack of school support					
Concern about Disclosure and reporting					

SECTION D

8. In what ways did the use of ICT deepen your knowledge in the teaching of physics?

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…….

How effective were the integration of ICT in the teaching and learning of physics?

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……..

How did the interactive learning experiences in the use of ICT in teaching physics impact the teaching and learning of physics?

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……

SECTION E

9. Indicate your level of agreement or disagreement to the statements below.

KEY: **S*A*** – *Strongly Agree;* ***A*** *– Agree;* ***N*** *– Neutral;* ***D*** *– Disagree;* ***SD*** *– Strongly Disagree*

FACTOR	RESPONSE				
Measures Implemented to mitigate challenges	**SA**	**A**	**N**	**D**	**SD**
Teacher Training					
Collaborative teaching					
Curriculum Development					
Community Engagement					
Resource Allocation					
Monitoring and Evaluation					

APPENDIX 2

INTERVIEW QUESTIONS FOR PHYSICS TEACHER

1. What types of ICT resources are available in physics classrooms and laboratories?
2. How accessible are these ICT resources to both teachers and students?
3. To what extent are physics teachers trained and comfortable in using ICT tools and integrating them effectively into their teaching practices?
4. What are the key challenges and barriers that physics teachers and schools face in effectively integrating ICT into physics education?
5. How are these challenges being addressed, and what strategies or solutions are being implemented to overcome them?
6. What professional development opportunities are available for teachers to enhance their ICT integration skills?
7. How do teachers perceive the usefulness and challenges of incorporating ICT in physics education?
8. How are physics teachers incorporating ICT tools and resources into their lesson planning and delivery?
9. What specific teaching strategies and pedagogical approaches are being employed to leverage the potential of ICT for enhanced learning in physics?

APPENDIX 3

INTERVIEW QUESTIONS FOR PHYSICS SCIENCE SCHOOLS INSPECTOR

1. What types of ICT resources are available in physics classrooms and laboratories?
2. How accessible are these ICT resources to both teachers and students?
3. To what extent are physics teachers trained and comfortable in using ICT tools and integrating them effectively into their teaching practices?
4. What are the key challenges and barriers that physics teachers and schools face in effectively integrating ICT into physics education?
5. How are these challenges being addressed, and what strategies or solutions are being implemented to overcome them?
6. What professional development opportunities are available for teachers to enhance their ICT integration skills?
7. How do teachers perceive the usefulness and challenges of incorporating ICT in physics education?
8. How are physics teachers incorporating ICT tools and resources into their lesson planning and delivery?
9. What specific teaching strategies and pedagogical approaches are being employed to leverage the potential of ICT for enhanced learning in physics?

APPENDIX 4

INTERVIEW QUESTIONS FOR PHYSICS SCHOOL HEAD

1. What types of ICT resources are available in physics classrooms and laboratories?
2. How accessible are these ICT resources to both teachers and students?
3. To what extent are physics teachers trained and comfortable in using ICT tools and integrating them effectively into their teaching practices?
4. What are the key challenges and barriers that physics teachers and schools face in effectively integrating ICT into physics education?
5. How are these challenges being addressed, and what strategies or solutions are being implemented to overcome them?
6. What professional development opportunities are available for teachers to enhance their ICT integration skills?
7. How do teachers perceive the usefulness and challenges of incorporating ICT in physics education?
8. How are physics teachers incorporating ICT tools and resources into their lesson planning and delivery?
9. What specific teaching strategies and pedagogical approaches are being employed to leverage the potential of ICT for enhanced learning in physics?