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AN INVESTIGATION INTO CHALLENGES ENCOUNTERED BY ORDINARY LEVEL PHYSICS LEARNERS WHEN DOING ELECTRONICS PRACTICALS: A CASE OF SECONDARY SCHOOLS IN HURUNGWE DISTRICT, ZIMBABWE

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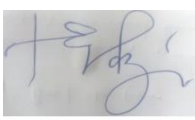

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DEDICATION

I dedicate this dissertation to my parents, who were the source towards my academic achievement, for that thank you.

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My deepest gratitude and appreciation towards the following people who guided and supported me to complete this research in a different way and without whom this research paper would not have been what it is.

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ABSTRACT

Physics learners in Zimbabwe, particularly those at the Ordinary school Level, encounter challenges in electronic practicals. This study investigated the challenges and common those are commonly encountered by learners when doing electronics practicals in their laboratories. It focused on rural secondary schools in Hurungwe District, Zimbabwe. The study involved 5 teachers, 3 school headmaster and 30 learners drawn from the three schools as participants obtained using purposive sampling. Data were collected using questionnaires, interviews, and observations. The qualitative data were then subjected to thematic analysis. The findings revealed a general lack of functional laboratory infrastructure in the three sampled schools, limited and unreliable infrastructure (power, internet, and computers), shortage of appropriate practical materials, inadequate teacher training insufficient time for the practicals, teachers had limited confidence in conducting electronic practicals due to insufficient training and exposure. Recommendations include having ministry of Primary and Secondary Education providing specific grants for science laboratory development in rural schools, rather than relying on general school levies. In addition, continuous professional development programs focusing on electronic practicals should be organized for Physics teachers. Workshops, in-service training, and peer-support systems should be prioritized

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CHAPTER 1: INTRODUCTION

1.1 Introduction

This chapter service as the introduction to the research study. It focuses on the background to the study, research problem, research questions, research objectives , research objectives, significance of the study, delimitation of the study and research limitations among other issues that gave the research a clear focus. Key terms that were used in the research study are also defined in the context of the study.

1.2 Background to the Study

A physics practical is a hands-on, experimental activity that uses physics apparatus to test, discover, or verify a scientific fact or principle. It is a crucial component of physics education that bridges the gap between theoretical concepts and real-world applications, helping students develop observational skills, analytical thinking, and a deeper understanding of the subject. Physics practicals are an integral part of physics research and physics instruction. In physics research, a practical activity is a reproducible empirical procedure for acquiring knowledge. Secondary school physics experiments can be broadly categorized by topic, such as motion (e.g., projectile motion, friction), electricity and magnetism (e.g., building motors, circuits, and electromagnets), and energy (e.g., potential/kinetic energy, thermal energy). Other common types include those exploring light and waves (e.g., diffraction, refraction) and properties of matter (e.g., density, pressure). This particular research study focused on electronics practicals. These practicals include a collection of experiments that demonstrate a wide range of physical concepts and processes involving electronics inclusive of its components. Generally there is designing of circuits using transistors and microchips, studying the behavior and movement of electrons in a semiconductor, conductor, vacuum, or gas etc. These practicals have proved to be not easy for most learners at ordinary school level. This has motivated the researcher to undertake this study.

The fact that science is about learning about the real world, knowledge of how things work suggests that students' knowledge should be applied to real life situations (Sadiq, 2003, Lunetta, et al. 2007). Hence it is not surprising that policy makers put much of the blame on science teachers for the lack of creativity and practical applications by the students. Physics practical work involves learning through selected contexts that promote students' motivation and engagement as a result of relevant learning episodes drawn from everyday experiences and phenomena (Stanley, 2000). Physics practical work provides students with opportunities for understanding and manipulating the complex and abstract nature of science in inducing effective conceptual change (Daramola, 1987). Physics practical work helps diagnose and remediate students' misconceptions. It motivates and interest's students in science (Nashon, 1989). As a result, physics practical work endears the learners to confirming and gathering new insight into scientific knowledge. They take charge of their own ability to investigate and question nature (Hirschfeld, 2012). This study is to investigate how physics practical work can help in learning physics and getting more students to get interested in the subject at secondary school.

Expressing the teaching of physics practical, Modupe Agagu (1980) wrote that "absence of a well-equipped laboratory in science teaching prevents the students from having the first experience about the subject" She also went on to say that the first-hand experience got by students during practical periods helps them in remembering the content of the subjects In North America, the integration of electronic practical lessons in secondary schools has become a cornerstone of modern education. Schools in the United States and Canada have adopted advanced technologies such as robotics, coding, and virtual labs to enhance students' understanding of scientific concepts. Smith & Johnson, (2018) asserts that these tools are embedded in curricula to foster critical thinking and problem-solving skills. However, disparities exist between urban and rural schools, with rural institutions often lagging due to limited resources and infrastructure. Studies highlight that rural schools face challenges such as inadequate funding, lack of trained teachers, and poor internet connectivity, which hinder the effective implementation of electronic practicals (Brown et al., 2020). Despite these challenges, North America remains a global leader in leveraging technology for education.

In Europe, electronic practical lessons are widely implemented, with countries like the United Kingdom, Germany, and Finland leading the way. European schools emphasize hands-on learning through digital tools, including simulations and interactive software, to complement theoretical knowledge (European Commission, 2019). The European Union has also invested heavily in digital education initiatives, aiming to bridge the gap between urban and rural schools. However, rural areas in Eastern Europe still face significant challenges, such as outdated equipment and limited access to high-speed internet (Müller & Schmidt, 2021). These disparities highlight the need for targeted interventions to ensure equitable access to electronic practicals across the continent.

In Asia, countries like South Korea, Japan, and Singapore have made remarkable strides in integrating electronic practical lessons into their education systems. These nations have invested heavily in digital infrastructure, ensuring that even rural schools have access to modern technologies (UNESCO, 2020). For instance, South Korea's "Smart Education" initiative provides students with tablets and laptops, enabling them to engage in electronic practicals seamlessly. However, in less developed Asian countries, such as Cambodia and Nepal, rural schools struggle with basic infrastructure, let alone advanced electronic tools (Kim & Lee, 2017). This disparity underscores the uneven progress in adopting electronic practicals across the region.

Studies conducted by Lopez et al., (2021) in South America faces significant challenges in implementing electronic practical lessons, particularly in rural areas. Countries like Brazil and Argentina have made efforts to introduce digital tools in schools, but progress remains slow due to economic instability and inadequate funding. Rural schools often lack electricity, computers, and internet access, making it nearly impossible to conduct electronic practicals. Studies indicate that teacher training in these regions is also insufficient, further exacerbating the problem (Lopez et al., 2021). Despite these hurdles, some initiatives, such as Brazil's "ProInfo" program, aim to provide digital resources to underserved schools, though their impact remains limited.

Across Africa, the adoption of electronic practical lessons in secondary schools is still in its infancy. While urban schools in countries like South Africa, Kenya, and Nigeria have begun integrating digital tools, rural schools remain largely excluded (Garcia & Fernandez, 2019). The continent faces numerous challenges, including poor infrastructure, lack of electricity, and insufficient funding for education. According to a report by the African Union, only 22% of rural schools in sub-Saharan Africa have access to basic digital resources (African Union, 2020; Moyo & Ndlovu, 2021). This stark digital divide highlights the urgent need for investment in technology and infrastructure to bridge the gap. In Southern Africa, the situation mirrors the broader African context, with significant disparities between urban and rural schools. Countries like South Africa and Botswana have made some progress in introducing electronic practicals, but rural areas continue to lag behind. In South Africa, for example, the "Paperless Classroom" initiative aims to provide tablets and digital content to schools, but its reach remains limited to urban centers. Rural schools often lack the necessary infrastructure, such as reliable electricity and internet connectivity, to support such initiatives (Department of Basic Education, South Africa, 2018). This uneven progress underscores the challenges of implementing electronic practicals in resource-constrained settings.

In Zimbabwe, the adoption of electronic practical lessons in secondary schools is hindered by a combination of economic, infrastructural, and social factors. The country's education system has faced significant challenges, including teacher strikes, inadequate funding, and a lack of modern teaching tools. While urban schools in cities like Harare and Bulawayo have begun to integrate digital technologies, rural schools remain largely excluded. A study by Ndlovu and Moyo (2020) found that only 15% of rural schools in Zimbabwe have access to computers, let alone the internet. This digital divide exacerbates existing inequalities in education. Hurungwe District, a rural area in Zimbabwe, faces unique challenges in implementing electronic practical lessons. The district is characterized by poor infrastructure, limited access to electricity, and a lack of trained teachers. Most schools in Hurungwe rely on traditional teaching methods, with little to no exposure to digital tools. According to a report by the Zimbabwe Ministry of Education (2021), only 5% of schools in Hurungwe have functional computer labs. This lack of resources severely limits students' ability to engage in electronic practicals, putting them at a disadvantage compared to their urban counterparts. The challenges faced by rural schools in Hurungwe District are emblematic of broader issues in Zimbabwe's education system. Economic instability has led to chronic underfunding of schools, particularly in rural areas (Chikomba & Muzenda, 2019). Teachers in these regions often lack the training and support needed to implement electronic practicals effectively. Additionally, the high cost of digital devices and internet connectivity makes it difficult for schools to acquire the necessary resources (Zimbabwe Ministry of

Education, 2021). These barriers highlight the need for targeted interventions to address the unique challenges faced by rural schools.

The lack of electronic practical lessons in rural schools has significant implications for students' academic performance and future prospects. Studies have shown that students who engage in hands-on, technology-driven learning tend to perform better in science and mathematics. However, students in rural areas, such as Hurungwe District, are often deprived of these opportunities, limiting their ability to compete in a globalized, technology-driven world (Ndlovu & Moyo, 2020). This disparity underscores the urgent need to address the challenges faced by rural schools.One of the primary challenges in implementing electronic practical lessons in Hurungwe District is the lack of infrastructure. Many schools in the district lack basic amenities such as electricity, which is essential for powering computers and other digital devices. Even in schools where electricity is available, frequent power outages disrupt lessons and hinder the effective use of technology (Zimbabwe Ministry of Education, 2021; Chikomba & Muzenda, 2019). This lack of reliable infrastructure poses a significant barrier to the adoption of electronic practicals.

Another major challenge is the lack of trained teachers who can effectively deliver electronic practical lessons. Many teachers in Hurungwe District have limited exposure to digital tools and lack the skills needed to integrate technology into their teaching. This is compounded by the lack of professional development opportunities, which are often unavailable in rural areas (Ndlovu & Moyo, 2020; Chikoko & Mhlanga, 2020). Without adequate training, teachers are unable to fully utilize the potential of electronic practicals to enhance student learning.

The high cost of digital devices and internet connectivity is another significant barrier to the implementation of electronic practical. Most schools in the district operate on limited budgets, making it difficult to purchase computers, tablets, and other necessary equipment. Additionally, the cost of internet access is prohibitively high for many schools, further limiting their ability to engage in digital learning (Zimbabwe Ministry of Education, 2021; Garcia & Fernandez, 2019). These financial constraints highlight the need for external support and funding to bridge the digital divide.

According to Searle (1972) "As far as science is concerned, experimentation is always exploratory or perhaps it would be more accurate to say information seeking. Experiments are undertaken to obtain new knowledge, to confirm predictions and to test the validity of assertion of others. In the laboratory which considers wasting time and they do not understand the importance of laboratory experiments (El-rabadi, 2013). Theoretical knowledge is always supported by the practical knowledge which helps students to expand their manipulative skills and scientific attitudes (Josiah, 2013). Therefore, practical work needs to be reinforced during physics class to change students' perception towards physics and improve the achievement. For this reason, researcher highlights, in this study, the effectiveness of teaching physics practical.

Abdullahi (2004) noted that material, equipment, laboratory facilities and appropriate experiments are necessary for the effective teaching of physics practical and learning physics as a whole; one is not astonished to find students within katsina metropolis record law percentage of passes than others in senior secondary schools certificate in physics. Judging from these facts, it could be stated that science laboratory and experiments are success determinants in the school physics practical and therefore the importance of laboratory equipment cannot be over emphasized

1.3 Statement of the Problem

The integration of electronic practical lessons in secondary schools has become a critical component of modern education, fostering hands-on learning, critical thinking, and problem-solving skills among students. Globally, regions such as North America, Europe, and parts of Asia have made significant strides in adopting digital tools and technologies to enhance science education. However, in developing regions, particularly in sub-Saharan Africa, the implementation of electronic practicals remains a significant challenge, especially in rural areas. Zimbabwe, like many other African nations, faces numerous barriers to the effective integration of electronic practical lessons in its education system. These challenges are exacerbated in rural districts such as Hurungwe, where schools grapple with inadequate infrastructure, limited access to electricity, and a lack of digital resources.

Despite the global push towards digital education, rural secondary schools in Hurungwe District continue to encountered challenges when doing electronics practicals. These challenges limits students' understanding of scientific concepts but also hinders their ability to develop essential 21^{st}-century skills and their challenges of passing the public examinations.. This has motivated the researcher to look at the challenges encountered by the learners with the hope of finding recommendations that can minimize the challenges if not removing them altogether

1.4 Purpose of study

This study seeks to investigate the challenges and common causes hindering the effective implementation of electronic practical lessons in rural secondary schools in Hurungwe District, Zimbabwe. By identifying these barriers, the research aims to provide insights into potential solutions that could bridge the digital divide and improve the quality of science education in rural areas. The findings of this study will contribute to the broader discourse on educational equity and the role of technology in addressing the unique challenges faced by rural schools in developing countries.

1.6 Research Questions

1. What are the physics electronics practicals done at ordinary level by physics learners in secondary schools in Hurungwe district, Zimbabwe
2. What are the challenges encountered when doing electronic practicals at ordinary level by physics learners in secondary schools in Hurungwe district, Zimbabwe
3. How can the challenges encountered when doing electronic practicals at ordinary level by physics learners in secondary schools in Hurungwe district be overcome

1.5 Research Objectives:

1. To identify Electronics practicals done at ordinary level by physics learners in secondary schools in Hurungwe district, Zimbabwe
2. To identify the challenges encountered when doing electronic practicals at ordinary level by physics learners in secondary schools in Hurungwe district, Zimbabwe
3. To find ways the challenges encountered when doing electronic practicals at ordinary level by physics learners in secondary schools in Hurungwe district be overcome.

4. To recommend to those people involved in physics education ways the challenges encountered when doing electronic practicals at ordinary level by physics learners in secondary schools in Hurungwe district be overcome.

1.7 Significance of Study

It is the hope of the researcher that the work will acquaint the physics teachers with the problems of physics practical teaching. Apart from this, it will also be of immense use to other teachers in Chemistry, Biology and Agricultural Science who are faced with similar problems. Furthermore, it will make the physics students know where emphasis should be laid to further enrich the study and learning of physics.

It will also help the teachers to understand the need to always supervised their students while carry out experiments and also to ensured that laboratory materials are not only adequate but also working condition and also see and understand the need to always display and discuss the safety, rules and regulations with the students.

It is also help the students to develop their knowledge of world and their understanding of some min ideas, theories and models that science uses to explain. It helps the students to learn to learn how to used laboratory equipment's and to follow some scientific procedures.

The study will pre-informed and post-informed, curriculum planners, school administration and government the problems facing both students and teachers in teaching and learning of physics practical. This will enable them to take quick action in view of the problems that emanated.

Finally parents would also get to know the problems encountered by their children and help them to correct the challenges faced. Hopefully this will help students to past their examination successfully and also percentage of massive failure in physics practical in ZIMSEC examinations among the schools that offered physics in Hurungwe will be decreased.

1.8 Limitations to the Study

One limitation of this study is the potential for biased responses from participants, particularly teachers and school administrators, who may feel pressured to provide socially desirable answers. This could affect the accuracy of data collected through interviews and questionnaires, as respondents might overstate the availability of resources or underreport challenges to present their schools in a positive light (Creswell & Creswell, 2018). Such bias could compromise the validity of the findings.

Time constraints pose another limitation, as the study may not capture long-term trends or changes in the implementation of electronic practical lessons. A longitudinal study would provide a more comprehensive understanding of the challenges and progress over time, but this is beyond the scope of the current research (Saunders et al., 2019). As a result, the findings may only reflect a snapshot of the situation.

Financial constraints may also limit the study, particularly in terms of accessing remote schools within Hurungwe District. Limited funding could restrict the number of schools visited or the depth of data collection, potentially excluding some of the most underserved institutions (Patton, 2015). This could skew the findings toward schools that are relatively better resourced.

The study may face challenges in accessing accurate and up-to-date records from schools, particularly regarding infrastructure and resource availability. In some cases, schools may lack proper documentation or may be unwilling to share sensitive information, which could hinder the accuracy of the data collected (Yin, 2018). This could limit the study's ability to provide a complete picture of the situation.

Another limitation is the potential for language barriers, particularly when conducting interviews or focus groups with participants who are not fluent in English. While efforts will be made to translate materials into local languages, nuances in responses may be lost, affecting the quality of the data (Creswell & Creswell, 2018). This could limit the depth of understanding of certain issues.

1.9 Delimitations to the Study

The study will focus on rural secondary schools in Hurungwe District, Zimbabwe, and does not include urban schools or other districts. This focus allows for an in-depth exploration of the unique challenges faced by rural schools but limits the generalizability of the findings to other contexts (Creswell & Creswell, 2018). The research is confined to public schools and does not include private schools.

The study is confined to the implementation of electronic practical lessons in science education and does not explore other subjects or disciplines. This delimitation ensures a focused investigation but excludes potential insights into the broader use of digital tools across the curriculum (Cohen et al., 2018). The study will focus on challenges and causes of implementing electronic practical lessons and does not propose or test specific interventions. While this allows for a thorough exploration of the problem, it limits the study's immediate practical applicability (Saunders et al., 2019).

The research is limited to the perspectives of teachers, school administrators, and students, excluding other stakeholders such as parents or policymakers. While this provides a focused lens, it may overlook valuable insights from other key players in the education system (Patton, 2015).

Finally, the study is delimited to qualitative methods, such as interviews, focus groups, and observations, and does not include quantitative data analysis. While this allows for rich, detailed insights, it limits the study's ability to provide statistical evidence or generalize findings (Cohen et al., 2018).

1.10 Definition of key terms

1.10.1 Physics

Physics is the study that deals with behavior of matter and energy.

1.10.2 infrastructure

Infrastructure The physical and organizational structures needed for the operation of electronic practical lessons, including electricity, computer labs, internet connectivity, and digital devices (Chikomba & Muzenda, 2019).

1.101.3 Electronic practical lesson

Electronic Practical Lessons refers to the use of digital tools, software, and technologies to conduct hands-on, interactive science experiments and activities in a classroom setting. (Smith & Johnson, 2018).

1.11 Summary

This chapter explores the challenges and causes of implementing electronic practical lessons in rural secondary schools in Hurungwe District, Zimbabwe. Overall, chapter one of the research paper provided a comprehensive overview of the background, problem statement, statement of the problem, research questions, significance of the study, and scope of the study related tothe challenges and causes of implementing electronic practical lessons in rural secondary schools in Hurungwe District, Zimbabwe

CHAPTER TWO: LITERATURE REVIEW

2.0 Introduction

This chapter focuses on a critical review of related literature which has been customized according to the objectives of the study for ease of use in discussing findings of this study in chapter four. The researcher was able to analyse and give critical review on issues that have been explored and studied both theoretically and empirically on literature that existed on electronics practical lessons at ordinary level

1.2 Theoretical framework

This study is based on the theory of constructivism. Constructivists view learning as an active process whereby learners learn to discover principles, concepts and facts for themselves. The instructor and the learners are equally involved in learning from each other

(Woolfolk, 2004). Crawford (1996) indicated that social constructivists, such as Vygotsky, emphasize the importance of the learner being actively involved in the learning process so that he/she can construct his/her own understanding. It is believed that learners with different skills and backgrounds need to collaborate on tasks, such as when they are doing practical work together in order to arrive at a shared understanding of the truth in a specific field. The term “constructionist teaching” is commonly used in the teaching and learning environments (Ritchie and Rigano, 1996, p .220). The teacher according to the constructivist theory is not seen as a person who is responsible for constructing knowledge for the learners but rather is denoted by the many responsibilities given to him\her during instruction in mediating meaning at the intermental plane in the classrooms. Thus, the teacher's role becomes that of a guide provocateur, creator of opportunity and codeveloper of understanding with learners. The instructional practices of the Biology teachers should therefore assist learners to acquire the process skills (Ritchie and Rigano, 1996).

The learner must play an active role in 'taking on' the new knowledge. He or she has to 'make sense' of the experiences and discourse of the science class, and use it to 'construct meaning'. In this essentially constructivist view of learning, however, the knowledge that we want the students to construct is already known to the teacher throughout. The teaching laboratory is therefore very different from the research laboratory.

Newman (1982p 26) points out that the young child is often thought of as a little scientist exploring the world and discovering the principles of its operation. We often forget that while the scientist is working on the border of humanknowledge and is finding out things that nobody yet knows, the child is finding out precisely what everybody already knows. An implication of this viewpoint is that practical tasks to develop students' scientific knowledge should be seen, and judged, as acts of communication and not as opportunities for enquiry. The primary criterion which a practical task of this sort should satisfy is that it is an effective means of communicating the idea(s) it is intended to convey. How, we might ask, and how effectively, does it augment other forms of communication (verbal, graphical, pictorial, symbolic) that teachers might use. By 'communication' here, I do not simply means acts of 'telling', but the whole range of activities that a teacher plans to encourage and support students as they attempt to construct personal meanings that are more closely aligned with the accepted scientific view.

Ever since experimental Science was advocated in the sixteenth century (Klainin, 1995), it has been well accepted that practical or empirical work is the major task of scientists. Thus, in order to educate our future leaders in science, there is a widespread belief that students should learn science by doing what scientists do (Klainin, 1995). Learning of Science therefore is seen by most Science educators as likely to be more effective if the child is involved in practical activities and takes an active part in the learning process. Practical work has been a prominent feature of school Science teaching from the late nineteenth century when Science was established as part of the curriculum of schooling in a number of countries (Klainin, 1995).

1.2.1 What is practical work

Practical work is used to refer to laboratory activities that include lectures, group experiments, and teacher demonstrations where learners are involved in handling and observing real objects and materials (Millar, Le Marechals & Tibergnien, 1999). Teachers should therefore provide opportunities for learners to handle materials, observe events, handle observation results and be able to draw conclusions.

In this paper, Practical work is referred to by the researcher as an activity that promotes active learner participation in learning. This definition does not only mean hands-on activity involving equipment, but also encompasses a range of other ways of working, including teacher demonstration, group discussion of problems and their solutions, interaction between students, and between students and teachers. It may involve individual activity such as measurement, observation and investigation. Thus practical work can take different forms from experiments to pencil and paper activity and may take place in the laboratory, classes or elsewhere. Namibia has included a practical work component in the teaching and learning of science. Learners in grade 11 and 12 are expected to do practical work in Physical Science and Biology. In grade 12, learners are assessed on practical skills in Paper 3 which is an alternative to course work in Biology. The inclusion of practical work is clearly stipulated in the Biology syllabus (Ministry of Education, 2009).

2.3 Impacts of Conducting Practical Lessons in Physics at Ordinary Level

The value of practical work has long been recognized at the secondary school level. Many teachers acknowledge the value of learning by doing rather than just being shown or told (Driver and Braund, 2002; p .222). If students can be allowed to do practical work in Biology, then this could help them understand the content better, because students learn better by doing. They will remember better something that they have done with their own hands. This was further emphasized by Hodson (1990) who said that practical work is an essential component of science and vocational subjects teaching. It is therefore advisable that students should be prepared with mastery of the skills required for practical work so that they will be ready for assessment.

Hodson (1990) further added that in practical work the candidate performs certain activities in order to discover something as yet unknown, to test a hypothesis or to check an already known fact. In order to perform these activities, the candidate has to learn the skills required for practical work, which includes preparing and performing experiments and processing the results obtained. Newman (undated, p .2) wrote: “We observed classes who studied chemistry and found that with few exceptions pupils enjoyed what they are doing in the laboratory even if difficulties arose in the procedures or even if students became aware that they didn’t understand what was happening, it didn’t seem to matter”. On the other hand, Woolnough and Allsop (1985, p. 201) noted that, “Many science teachers recognized the importance of practical work. They believed that pupils should have first-hand practical experience in laboratories in order to acquire skills in handling apparatus, to measure and to illustrate concepts and principles”. Having first hand information will allow students to apply the skills acquired during practical work when they become scientists in future.

2.3.1 Practical work is essential for developing students’ scientific knowledge

Given that the subject matter of science is the material world, it seems natural, and rather obvious, that learning science should involve seeing, handling and manipulating real objects and materials, and that teaching science will involve acts of ‘showing’ as well as of ‘telling. Conducting practical lessons in physics at the ordinary level significantly enhances students’ conceptual understanding. Research by Raghavan et al. (2019) demonstrates that hands-on experiences allow students to visualize abstract concepts, making them easier to comprehend. When students engage in practical activities, they can see the real-world applications of theoretical principles, bridging the gap between theory and practice. Such experiential learning fosters deeper cognitive processing, as students actively participate in their learning journey. Piaget argues that we construct increasingly sophisticated and powerful representations of the world by acting on it in the light of our current understandings, and modifying these in the light of the data this generates. Through

action on the world, we generate sensory data which can either be assimilated into existing schemas or require that these be changed to accommodate the new data, in order to re-establish equilibrium between the internal and external realities. Through such action, we construct a view of the objects that exist in the world, what they are made of and what can be made from them, what they can do and what can be done to them

Furthermore, practical lessons encourage students to ask questions and explore phenomena, promoting critical thinking skills. A study by Finkelstein et al. (2005) supports this notion, indicating that students who participate in laboratory work perform better in understanding fundamental concepts. This active involvement not only solidifies their learning but also cultivates a sense of curiosity about the subject matter. Overall, practical lessons are crucial for developing a strong foundational understanding of physics concepts at the ordinary level.

2.3.2 Development of Practical Skills

Another significant impact of conducting practical lessons in physics is the development of essential practical skills among students. Engaging in hands-on experiments enables students to acquire technical skills, such as measuring, data recording, and equipment handling. Research by Mavrikis et al. (2019) highlights that students who participate in practical lessons demonstrate improved proficiency in using scientific instruments. These skills are vital not only for academic success but also for future careers in science and technology. Additionally, practical lessons foster problem-solving abilities as students encounter challenges during experiments and learn to troubleshoot effectively. A study by Karp and Zilberstein (2020) emphasizes that these skills are transferable, benefiting students in various fields beyond physics. Moreover, the ability to conduct experiments independently fosters a sense of responsibility and confidence in students. Thus, the development of practical skills through hands-on learning is instrumental in preparing students for further education and professional opportunities.

2.3.3 Promotion of Collaborative Learning

Practical lessons in physics promote collaborative learning, which enhances students' social skills and teamwork abilities. During group experiments, students work together, sharing ideas and negotiating solutions to problems. Research conducted by Johnson and Johnson (2018) indicates that collaborative learning environments lead to improved communication skills and greater retention of knowledge. By engaging with peers, students also gain diverse perspectives, enriching their understanding of concepts.

Furthermore, collaboration fosters a sense of community within the classroom, encouraging students to support one another in their learning journeys. A study by Hwang et al. (2017) found that students who engage in collaborative practical work report higher levels of motivation and enjoyment in the subject. Additionally, these interactions help students develop conflict resolution skills, preparing them for future collaborative endeavors in academia and the workplace. Overall, practical lessons that incorporate group work contribute significantly to the development of essential interpersonal skills.

2.3.4 Increased Motivation and Engagement

The incorporation of practical lessons in physics greatly increases student motivation and engagement. Research by Alsharif et al. (2020) found that hands-on activities evoke enthusiasm and curiosity, making learning more enjoyable for students. When students can actively participate in their education, they are more likely to stay engaged and invested in the learning process. Practical lessons provide immediate feedback through experimentation, allowing students to see the relevance of their studies in real-time. Furthermore, the dynamic nature of hands-on activities breaks the monotony of traditional lectures, capturing students' attention more effectively. A study by Tufekci and Aydin (2018) emphasizes that increased engagement leads to improved academic performance and a positive attitude toward the subject. This heightened motivation often translates into a greater willingness to explore physics concepts beyond the classroom. Thus, practical lessons play a vital role in fostering a lifelong interest in science among students.

2.3.5 Improvement in Critical Thinking Skills

Conducting practical lessons in physics enhances critical thinking skills, which are essential for academic and professional success. Engaging in hands-on experiments requires students to formulate hypotheses, analyze data, and draw conclusions based on their observations. Research by Chukwuma et al. (2020) highlights that students who participate in practical activities develop stronger analytical skills compared to those who rely solely on theoretical instruction. This analytical approach encourages students to question assumptions and evaluate evidence, fostering a deeper understanding of the scientific method. Furthermore, practical lessons provide opportunities for students to engage in inquiry-based learning, where they can investigate phenomena and derive their conclusions. A study by Lee and Choi (2021) found that inquiry-based practical lessons significantly improve students’ ability to think critically and apply their knowledge to new situations. The emphasis on critical thinking not only prepares students for academic challenges but also equips them for problem-solving in real-life scenarios. Therefore, practical lessons are instrumental in developing the critical thinking skills necessary for success in various fields.

2.3.6 Facilitation of Concept Retention

Practical lessons in physics are effective in facilitating concept retention among students. Engaging in hands-on experiments allows students to reinforce their understanding of theoretical principles, leading to better memory retention. Research by Eze et al. (2021) indicates that students who participate in practical activities demonstrate higher retention rates compared to those who learn exclusively through lectures. The active involvement in experiments creates lasting memories associated with the learning experience, making it easier for students to recall information during assessments. Additionally, the repetitive nature of practical work helps solidify concepts, as students learn through trial and error. A study by Osei et al. (2019) emphasizes the importance of experiential learning in enhancing long-term memory retention. Furthermore, practical lessons encourage students to connect new information with prior knowledge, further improving retention rates. Thus, the facilitation of concept retention through practical lessons is crucial for ensuring students’ academic success in physics.

2.3.7 Relevance to Real-World Applications

Conducting practical lessons in physics highlights the relevance of scientific principles to real-world applications. Engaging in experiments allows students to see how concepts are applied in everyday life, fostering a deeper appreciation for the subject. Research by Brown and Lee (2018) indicates that students who participate in practical lessons are more likely to recognize the importance of physics in various fields, such as engineering and technology. This awareness enhances their motivation to learn and explore further, as they understand the practical implications of their studies. Furthermore, practical lessons often incorporate current technological advancements, making the learning experience more relevant and engaging. A study by Kauffman et al. (2020) emphasizes that students who see the connections between physics and real-world scenarios are more likely to pursue careers in science and engineering. By bridging the gap between theory and practice, practical lessons prepare students for future challenges and opportunities. Overall, the emphasis on real-world applications in practical lessons is essential for cultivating a strong interest in physics.

2.4 Challenges in Teaching and Learning Electronics Practicals in Physics

Despite the numerous benefits of conducting practical lessons in physics, challenges in implementation remain prevalent. The teaching of practical lessons is not spared from drawbacks which inhibit the achievement of set goals. The factors such as unavailability of science teachers in schools, lack of materials, lack of funds and time have constrained the teaching of Biology practical lessons. Consequently, many students fail to perform well in Biology because of inadequacy of instructional material such as laboratories, chemicals, models, apparatus, local specimens and shortage of textbook

2.4.1 Resource Availability

The availability of resources is a significant challenge in the teaching and learning of electronics practicals in physics. Research by Alsharif et al. (2020) highlighted that many educational institutions lack the necessary equipment and materials, which adversely affects students' hands-on learning experiences. This scarcity can hinder students' ability to engage effectively with the subject matter, as practical experience is crucial for understanding theoretical concepts. Limited access to modern tools can also diminish the relevance of the curriculum, as outdated equipment often fails to reflect current technological advancements. Furthermore, financial constraints faced by schools limit the procurement of essential components, creating gaps in instructional capabilities. A study by Okere and Nwankwo (2019) emphasized how these limitations lead to incomplete experiments, adversely impacting students' comprehension.

Ramorogo (1998) explored teachers' perceptions of practical work in Biology in Botswana secondary schools. He found that in large classes, the shortage of laboratories and the lack of laboratory assistants were serious impediments to teachers in involving students in meaningful practical activities. On the other hand, Leach et al. (1999) reviewed the use of practical work in science education in different countries. They found that in many countries, teachers spent or claimed that they spent considerable amounts of time in supervising laboratory work. However, they found that the bulk of science assessment was traditionally non-practical.

Teachers often resort to theoretical explanations without practical demonstrations, leading to a disconnection between theory and application. Consequently, addressing resource availability is essential for enhancing the quality of education in electronics and ensuring that students are adequately prepared for future technological challenges. Thus, increased investment in educational resources is critical for improving the learning environment.

2.4.2 Instructor Expertise

The expertise of instructors presents another challenge in the teaching of electronics practicals. Research conducted by Hwang et al. (2017) reveals that varying levels of knowledge and experience among educators can result in inconsistencies in teaching quality. Instructors who lack confidence in their understanding of complex concepts may struggle to deliver effective instruction, which can lead to students receiving inadequate guidance. This gap in expertise can create a disconnect between theoretical lessons and practical applications, ultimately affecting student motivation and interest. Additionally, the rapid advancement of technology means that educators must continuously update their knowledge and skills, which can be a daunting task. A study by Lee and Choi (2021) found that many instructors feel overwhelmed by the need to stay current, leading to reluctance in adopting new teaching methods. Professional development opportunities are often limited, exacerbating the challenge of maintaining instructor expertise. When teachers are not well-versed in their subject matter, it can hinder students' overall learning experience. Therefore, enhancing instructor expertise through targeted professional development is crucial for improving the quality of electronics education.

2.4.3 Student Engagement

Student engagement is a critical challenge in electronics practicals, as many learners find the subject matter difficult and uninteresting. Research by Tufekci and Aydin (2018) indicates that the abstract nature of many electronics concepts can lead to frustration, causing students to disengage from practical work. Without active participation, students are less likely to retain information or develop essential skills necessary for their future careers. Moreover, traditional teaching methods often fail to captivate students' interest, leading to a perception that the subject lacks relevance. A study by Mavrikis et al. (2019) emphasizes the importance of interactive learning techniques, which are often underutilized due to time constraints and rigid curricula. Additionally, diverse learning styles among students necessitate differentiated instruction, which can be challenging for teachers to implement effectively. When students do not see value in electronics practicals, their overall learning experience suffers, leading to lower performance. Thus, fostering student engagement through innovative teaching strategies and real-world applications is essential for enhancing the educational experience in electronics. Creating a more engaging curriculum can significantly improve student motivation and learning outcomes.

2.4.4 Safety Concerns

Safety concerns in electronics practicals represent another significant challenge that educators must address. The potential risks associated with handling electrical components and tools necessitate a strong emphasis on safety protocols. Research by Ibenne et al. (2021) highlights that inadequate safety training can lead to accidents, creating anxiety among students and deterring them from fully engaging in practical work. Instructors often find themselves spending a considerable amount of time on safety measures, which can detract from the actual learning experience. Furthermore, many institutions lack proper safety equipment, increasing the risk of accidents and injuries. When students perceive the learning environment as unsafe, their willingness to experiment and explore diminishes, limiting the effectiveness of practical learning. A study by Chukwuma et al. (2020) emphasizes the importance of integrating safety education into the curriculum to foster a culture of safety awareness. Additionally, inadequate training on safety measures can result in improper handling of equipment, leading to costly mistakes. Therefore, addressing safety concerns while maintaining an engaging learning environment is essential for effective teaching and learning in electronics.

2.4.4. Curriculum Limitations

Curriculum limitations pose a significant barrier to effective teaching and learning in electronics practicals. Often, curricula are heavily weighted towards theoretical aspects, leaving little room for practical application. A study by Mari et al. (2019) found that this imbalance often results in students feeling unprepared for real-world scenarios where hands-on skills are crucial. Furthermore, the rigid nature of many curricula does not accommodate emerging technologies, which are vital for keeping pace with industry demands. Educators may find it challenging to integrate new topics into an already packed syllabus, leading to outdated content being taught. Additionally, standardized assessments often emphasize theoretical knowledge over practical skills, discouraging educators from prioritizing hands-on learning experiences. Students may graduate with a solid theoretical foundation but lack the practical skills needed for employment, as highlighted in research by Karp and Zilberstein (2020). A more flexible curriculum that incorporates practical components and current technologies is necessary to foster a well-rounded learning experience. Reevaluating curriculum design is crucial for enhancing the quality of electronics education and better preparing students for future challenges.

2.4.5 Time Constraints

Time constraints are a pervasive challenge in the teaching and learning of electronics practicals. Research by Osei et al. (2019) indicates that the limited duration of class periods often prevents comprehensive exploration of practical activities. Instructors may feel pressured to cover extensive syllabi, leading to a rushed approach that sacrifices depth for breadth. This hurried instruction can result in superficial understanding and inadequate skill development among students. Furthermore, the pressure to prepare students for standardized tests can further limit the time allocated for practical work, creating an environment that prioritizes rote learning. As a result, students may miss out on valuable hands-on experiences that reinforce theoretical learning, as highlighted in the study by Cavanagh and Pritchard (2021). Additionally, the need for thorough preparation and setup for experiments can consume valuable instructional time, making it challenging to balance theoretical instruction with practical applications. Therefore, finding ways to allocate sufficient time for practical learning is essential for effective education in electronics and physics. Addressing these time constraints is crucial for creating a more enriching learning environment.

2.4.5 Technological Adaptation

The rapid pace of technological advancements presents a challenge for both educators and students in electronics practicals. Research conducted by Kauffman et al. (2020) reveals that keeping up with new tools and techniques can be overwhelming for instructors who may not have received training in emerging technologies. This gap in knowledge can hinder effective teaching and create a disconnect between students and current industry practices. Furthermore, students may feel intimidated by new technologies, leading to a lack of confidence in their abilities, as documented in a study by Brown and Lee (2018). The integration of technology into practical work requires ongoing professional development for educators, which is often not readily available. Additionally, students may lack access to modern technologies outside the classroom, limiting their ability to practice and explore independently. This disparity can create inequities in learning opportunities among students, further exacerbating the challenge of technological adaptation. To address these challenges, both educators and students must embrace continuous learning and adaptation. Fostering a culture of technological adaptability is vital for improving electronics education and ensuring students are prepared for future challenges.

Strategies to improve teaching practicals

Strategies for improving practical work intended to develop students' scientific knowledge have a common aim – to make the students think as well as act. Effective tasks are those where students are not only 'hands on' but also 'minds on' (Duckworth, 1990). Increasing their prevalence requires first that teachers become more aware that making links between the domain of objects and observables and the domain of ideas is demanding, and then helping them to design practical tasks which take this demand more explicitly and fully into account – tasks which 'scaffold' students' efforts to make these links. This in turn requires that teachers analyse more carefully the objectives of the practical tasks they undertake, and become more aware of the cognitive challenge for their students. The starting point for improving practical work is therefore to help teachers become much clearer than many are at present about the learning objectives of the practical tasks they use.

2.5 Summary

This chapter focuses on a critical review of related literature which has been customized according to the objectives of the study for ease of use in discussing findings of this study in chapter four. The researcher was able to analyse and give critical review on issues that have been explored and studied both theoretically and empirically on literature that existed on challenges and opportunities of electronic practical at ordinary level. The next chapter focuses research methodology.

CHAPTER 3 RESEARCH METHODOLOGY

3.0 introduction

This section outlines the research methodology to be used in this study. Methodology is used here to refer to approaches and various ways used to gather and analyse data. According to Henning (2009:55) methodology "is a coherent group of methods thatcomplement one another and that have the ability to fit together to gather data and conclusions that will answer research questions and achieve the researcher's objectives. Similarly, Halloway (2015:88) defines research methodology as "a framework of theories and principles on which methods and procedures are based". In this section therefore the research approach, the study design and the population and sample to be used are described. The data collection methods and tools to be employed to gather data including measures to be taken to enhance trustworthiness and dependability of the tools are also described. The ethical considerations to be adopted as well as the data analysis procedures are stated. More importantly the rationale and justification for the choice of approach is stated and explained in detail.

3.1 Research approach

A research approach refers to the systematic plan or strategy devised to conduct research and solve a specific research problem. It encompasses the theoretical framework, data collection methods, and analysis techniques used to explore a research question. There are several research approaches that researchers can adopt based on the nature of the research problem, objectives, and available resources. According to Creswell (2014), a research approach is a plan that provides a systematic roadmap for conducting research by outlining the theoretical framework, data collection methods, and analysis techniques to be employed. It helps researchers establish the credibility and rigor of their study and ensures that the research findings are valid and reliable. Denzin and Lincoln (2018) define a research approach as a set of principles, procedures, and protocols that guide the researcher in generating knowledge about a particular topic or phenomenon. It involves making decisions about the design, data collection, and analysis methods to be used in the study and ensures that the research is conducted ethically and effectively. Leedy and Ormrod (2015) describe a research approach as the overarching plan that guides the researcher in formulating research questions, collecting and analyzing data, and interpreting findings. It helps researchers make informed decisions about the research process and ensures that the study is conducted in a systematic and organized manner.

Different research approaches that can be used include quantitative, qualitative, and mixed methods approaches. Quantitative research involves collecting and analyzing numerical data to test hypotheses and make generalizations about a population. Qualitative research, on the other hand, focuses on exploring individual experiences, perceptions, and meanings through in-depth interviews, observations, and textual analysis. Mixed methods research combines both quantitative and qualitative approaches to provide a more comprehensive understanding of a research problem.

In conducting research on the challenges and opportunities of electronic practical, a qualitative research approach would be most suitable. Qualitative research methods are well-suited for exploring complex phenomena such as teaching and learning practices, as they allow researchers to delve deeply into the experiences and perspectives of participants (Creswell, 2013).

3.2 Research design

Burns and Grove (2012) define a research design as a plan or roadmap for undertaking a research. A case study design will be adopted for the study. The reason for using a case study is to have insights and examine modern real-life events through a comprehensive analysis of selected events or situations and their connections within a given context. The case study design will enable the researcher to closely examine the data within a specific context (Yin, 2014). Case study design enables intensive study of a unit. The design makes it possible to investigate and explore an event thoroughly and deeply. Merrian (2013) suggests that case study design is valuable in analyzing continuously the life of a social unit to dig out the facts. It can be noted that case study design compares different type of facts about the study of a unity and in the process it gives the analytical power of a person to increase knowledge about social phenomena. More importantly case study method provides grounds for generalization of data. This is a case study of the challenges and opportunities of practical activities in physics at ordinary leve will be used.). In this study it is used to answer questions on the challenges and opportunities for practicals at ordinary school level in physics. This design involves an in-depth investigation of a single case or a small number of cases, and is well-suited for exploring complex phenomena in real-world contexts.

A case study design would allow the researcher to examine the teaching and learning of electronics practical in a detailed and holistic manner, taking into account the specific context and dynamics at play. The researcher would be able to gather in-depth data through observations, interviews, and questionnaires, and to gain a rich understanding of the factors influencing the teaching and learning of electronics in this specific setting.

Additionally, a case study design would allow the researcher to draw on multiple sources of evidence and to triangulate data from different perspectives, enhancing the validity and reliability of the study findings. This design would also enable the researcher to generate rich, detailed descriptions of the teaching and learning processes, and to provide insightful recommendations for improving practice in this area.

3.3 Population

According to Burns and Grove (2013), a population is defined as all elements (individuals, objects and events) that meet the sample criteria for inclusion in a study. Chiromo, (2002) defines a population as any group of individuals that has one or more characteristics in common that are of interest to the researcher. According to McMillan (2006) a population is defined as group of elements or individual objects or events that conform to specific criteria and to which we intend generalize the results of the research. Population refers to any group of individuals that has one or characteristics in common, that are of interest of the researcher".[Munyaradzi 2014:40, Cohen et-al 2011]

In this research, the population under study was in three secondary schools in Hurungwe District. Usually in educational research, the population is made of students, teachers, and administrators.

This is the group in which the researcher developed interest and would like to generalize the results of the study through its involvement

3.4 Sampling and sample

3.4.1 Sample

Chisi et al (2004) defines a sample a subset of a population under investigation. Neuman (2000) alludes that a sample is a smaller unit or a group of population on which information is obtained to reflect the characteristics of the entire population. This implies that a sample is a proportion which represents the entire population in the area of study.

A sample was collated from 3 school heads, 3 specialized music teachers and 12 generalist teachers with a goal to address challenges faced by Teachers in teaching percussion music. A sample enabled the research to be easily carried out. Thus sampling helped to reduce and serve time in carrying out the research. Borg and Gall [2005] pointed out that time, money and effort involved in carrying out a research do not permit to study the entire population.

3.4.2 Sampling technique and sample

In this study, the researcher used cluster and purposive sampling procedures. Cluster sampling enabled the researcher to come up with the number of schools involved in the research study. Chiromo [2006:8], cluster sampling involves randomly selecting a specific number, like schools, and testing participants in those selected schools. The researcher selected school heads, physics teachers and learners as participants. Cluster sampling was cost effective as it saved time and money as groups of naturally occupying individuals at the schools were drawn in one unit.

Random sampling will be used to select the physics teachers. Random sampling entails that each and every member of the population under study stands a chance of participating in the research (as is the main goal of probability sampling). Simple random sampling will be conducted by allotting a number to each participant in the population list after which a random number table to draw out the members of the sample is used (MacNealy 2012). Purposive sampling will be used to select the Heads of schools. A sample of 6 teachers and 3 Heads of schools will be selected from this study.

3.4 Data collection procedures

According to Burges (2016:90) data collection is the systematic approach to gathering and collation of information from participants using a number of sources. Data collection enhances one to answer research questions, make the necessary evaluation of results and draw conclusions about what will likely happen in future. In this study in-depth interviews, document analysis and questionnaires will be used as methods of collecting data.

3.5 Research instruments

These are the fact finding strategies. They are the tools for data collection. The following research instruments will be administered:

3.5.1 In-depth Interviews

An interview schedule will be designed to guide the in-depth interview process. Interviews will be conducted with the physics teachers . According to Lofland and Lofland (2015) an in-depth interview is often considered as a form of conversation. Interviews will be conducted because they will permit collection of data in a more conducive environment. Spradley (2009) asserts that there are a number of stages in an in-depth interview. Interviews can be employed in cases where interviewees are not comfortable responding to question in a group environment. The use of in-depth interviews as a data collection method will enhance flexibility and interaction between the researcher and respondent. Participants in an in-depth interview will express their feeling in a manner not possible when using a rating scale or questionnaire.

3.5.2 Questionnaires

In this research study the questionnaire was used to collect data. A questionnaires will be used to collect data, from school heads . All questionnaires contained the same questions and same lay out.

Questionnaires were also used as a convenient data collection technique. The researcher administered the questionnaires in order to address queries and uncertainties that could arise. The questionnaires sought to extract data that are rooted deep in the mind of the respondent. The question content and phrasing was kept as simple and concise as possible and the answers required were definite.

3.5.2.1 Advantages of questionnaires

Responses from a large sample can be obtained within a short period of time. This instrument proved efficient in getting information from a wide spectrum of respondents in the area of study.

Descombe [2010] avers that questionnaires are economically, in the sense that they can supply a considerable amount of research data for relatively low cost of materials and time.

The results from the questionnaires are easy to analyze. Respondents are free to say their minds and also work on their own pace and during their most convenient time.

Questionnaires also permit greater coverage through the selection of a large and more representative sample.

It provides a great degree of anonymity and confidentiality to the participants thereby safeguarding them from victimization. Frankel and Wallen [2002] says that a questionnaire gives confidence where there is apparent identification of respondent thereby giving valid information.

Data collection using questionnaires are more uniform and standard since all the subjects are given the same questionnaire. This easies presentation, analysis and interpretation.

3.5.2.2 Disadvantages of questionnaires

The questionnaire may be completed by another person on behalf of the intended respondent. Borg and Gall [2001] in support says questionnaires can be answered by someone who is not part of the sample especially in cases of mailed questionnaires.

Some respondents may decide not to complete some sections of the questionnaires or they may completed them and fail to return them back to the researcher. Questionnaires are convenient to people who can read and write

3.5.3 Observations

According to Bryman (2016), observation in research involves the systematic watching of people, objects, or events in order to record information and generate insights. According to Merriam and Tisdell (2015), observation in research involves not just looking at an event, but also interpreting and making meaning of the observed data. This definition emphasizes the importance of analytical thinking and interpretation in the observational process.

According to Creswell and Poth (2018), observation in research involves engaging with the participants or environment in a natural and unobtrusive manner, in order to gain insider perspectives and insights. This definition highlights the importance of context and immersion in the observational process.

Classroom observations are a valuable research method that allows researchers to gain in-depth insights into how teaching and learning are being carried out in real-time. For the current researcher conducting a study on the challenges and opportunities observations are crucial for several reasons.

First and foremost, classroom observations provide a detailed and accurate picture of how practical activities are being integrated into the teaching and learning of physics at ordinary school level. By directly observing teachers and students in action, the researcher can see firsthand how tools and resources are being used, the level of engagement of students, and the effectiveness of teaching strategies. This type of real-time data is essential for understanding the current state of practical activities in physics and can help identify areas for improvement.

Additionally, practical observations allow the researcher to observe the interactions between teachers and students, as well as among students themselves. This can provide valuable insights into how practical activities are impacting the dynamics of teaching and learning of physics and how it is being used to support collaborative learning and problem-solving.

Furthermore, practical observations offer a unique opportunity for the researcher to gather qualitative data that may not be captured through other research methods, such as surveys or interviews. By observing classroom activities, the researcher can gather rich, detailed information about the context in which practical is being taught and learned, including the physical environment, instructional materials, and cultural factors that may influence teaching and learning practices.

In addition to providing valuable data for the research study, classroom observations can also have practical implications for teachers and school administrators. By observing classroom practices and identifying areas for improvement, the researcher can provide feedback and recommendations that can help enhance the quality of electronics practical education in rural schools. This collaboration between researchers and practitioners can lead to more effective teaching strategies, better use of resources, and ultimately improved learning outcomes for students. The type of observation that will be engaged in for the study on the teaching and learning of electronics practical's will be a combination of participant observation and naturalistic observation. This approach will provide a thorough and detailed examination of the dynamics of the classroom and the experiences of both teachers and students in relation electronics practical.

3.6. Pilot testing

A pilot study is a mini-version of a full-scale study or a trial run done in preparation of the complete study. The latter is also called a 'feasibility' study. It can also be a specific pre-testing of research instruments, including questionnaires or interview schedules. (Van Teijlingen and Hundley, 2001) The pilot study will thus follow after the researcher has a clear vision of the research topic and questions, the techniques and methods, which will be applied, and what the research schedule will look like. It is "reassessment without tears" (Blaxter, Hughes & Tight, 1996:121), trying out all research techniques and methods, which the researcher have in mind to see how well they will work in practice. If necessary it can then still be adapted and modified accordingly. (Blaxter, Hughes & Tight, 1996:121) The pilot study in the current research can be defined as mainly a tryout of research techniques and methods, but also of questionnaires and interviews and the observation schedule.

The purpose in this study is to make sure that everyone in the sample not only understands the questions, but understands them in the same way. This way the researcher will check whether any of the questions make respondents feel uncomfortable and will check out how long it takes to complete the questionnaire in real time among others. The pilot testing will be done once the project supervisor and the researcher are confident with the process that the study has reached. It will be done with a few of the teachers who will not take part in the main study. Participants to the pilot test will be encouraged to state their comments and criticisms with respect to the length of the questionnaire, the words used, sentence structure and any ambiguous statements or confusing questions and clarity of the procurement and logistics terms used. The objective of the pilot study will be to ensure that respondents understand the instructions, the questions being asked, the terminologies used, no misleading questions, that clarity was observed and that the instruments used were reliable to the subject being studied. To this end, the returned questionnaires will be looked at thoroughly for more corrective inputs. All input in the forms of comments, suggestions, ideas, proposals, corrections and views will be taken into consideration to improve, improvise and upgrade the level of reliability of the instrument.

3.7 Triangulation

Triangulation is a process used by researchers to enhance the research’s validity. According to Brown and Dowling (2018) it is the use of different methods or tools to gather data in research in-order to have a deeper appreciation of the issue under study. Triangulation facilitates validating data through cross verification from more than two sources. Triangulation tests the consistency of findings obtained through different instruments and increases the chances to control or to assess some of the threats or multiple causes influencing the research findings . In this study data triangulation entail the comparison of data received from in-depth interviews and questionnaires administered

3.8 Ethical consideration

Conducting of research requires not only expertise and diligence, but also honesty and integrity. The idea is to protect the rights of research participants. Ethical issues that the researcher needs to take note of include voluntary participation, anonymity, confidentiality and informed consent among others. Written permission to conduct the research study will be obtained from the authorities. The participants' consent will be obtained before they completed the questionnaires and engage in interviews. Burns and Grove (2003:776) define informed consent as the prospective subject's agreement to participate voluntarily in a study, which is reached after assimilation of essential information about the study. Anonymity and confidentiality will be maintained throughout the study. Burns and Grove (2003:762) define anonymity as when subjects cannot be linked, even by the researcher, with his or her individual responses. In this study anonymity will be ensured by not disclosing the participant's name on the questionnaire and research reports and detaching the written consent from the questionnaire. Confidentiality entails that the researcher will under no circumstances divulge information gathered from research participants (Polit and Hungler 2014). In this study, the researcher will endeavour to keep all gathered information with the anonymity it deserves (Burns and Grove 2003: 99). No identifying information will be recorded the survey tool, and numbering of questionnaire will be done only after data is collected (Polit and Hungler 2014).

3.9 Data analysis procedures

Marshall and Rossman (2017) describe data analysis as the process of bringing order, structure and meaning to the mass of collected data. Data analysis for the questionnaire will be done by using the simple statistical methods of using tables and graphs. All questions from the questionnaire will be individually analyzed, taking into considerations all the available factors and supported with descriptive and inferential analysis. The thematic principle is applied in respect of qualitative data from interviews. The collected information will be sieved, sorted, grouped and assembled in accordance with the question numbers that acted as the coding system in order to solicit the emerging issues/points and to establish certain patterns in all the answers (Merrian, 2013). In the process of the actual report writing and for the purpose to increase the credibility of qualitative data, member checking will be done vigorously with the interviewees, both to clarify and verify their statements and to validate whatever that they had said. Respondents' validation is important to improve accuracy.

3.10 Chapter summary

The chapter explained and elaborated on my methodological choices as they informed the study. The researcher justified his choice of research design and the primary data generation methods and instruments that will be used to aid in the answering of critical questions of this study. Furthermore, the researcher explained the need for respecting ethical issues that are considered significant to the study. The chapter concluded with a discussion of the steps that will be taken to ensure the validity and reliability of the study as well as the data analysis procedures. The next chapter presents the data collected from the field, analyses and interprets it and discusses the data.

4.0 CHAPTER FOUR: DATA PRESENTATION AND ANALYSIS

4.0 Introduction

In the previous chapter the emphasis was on research methodology employed in carrying out this study. This chapter will look at data presentation and analysis.

SECTION A

4.2.1 How many Physics teachers do you have, and how many students take Physics at Ordinary Level?

All heads confirmed a shortage of Physics teachers compared to student demand. Head 1 explained: "We only have one Physics teacher, yet over 120 students are taking Physics at O-Level." Similarly, Head 2 remarked: "There are two teachers, but one is not specialized in Physics; he is from Mathematics and struggles with practicals." Head 3 added: "The teacher-student ratio is overwhelming, making it hard to offer individual attention during practicals." This imbalance demonstrates systemic shortages of science teachers in rural Zimbabwe. The mismatch between teacher numbers and enrolments aligns with Chikomba (2020), who reported that under-staffing in rural schools affects quality delivery, particularly in specialized subjects like Physics.

4.2.2 Facilities does to support Physics electronic practical lessons

All three heads admitted that facilities were inadequate for electronic practicals.

Head 1 noted: "We do not have oscilloscopes, power supplies, or signal generators. Only a few multimeters are available, but they are often not working."

Head 2 explained: "We use an old general lab, which lacks proper workstations for electronics."

Head 3 added: "Even basic items like connecting wires and resistors are in short supply." These responses suggest schools are grossly under-resourced in electronic equipment. This confirms earlier research (Mushayabasa, 2018), which concluded that Physics practicals are poorly supported in rural areas, making students less competitive in national exams.

4.2.3 How adequacy or inadequacy of this infrastructure affect lesson delivery

The school heads highlighted that inadequate infrastructure results in teaching being mainly theoretical.

Head 1 said: "Learners cannot see or touch real equipment; everything is explained verbally."

Head 2 echoed: "Students only meet real apparatus at exam time, which disadvantages them."

Head 3 added: “Because we lack facilities, many learners lose interest in Physics.” This shows a disconnect between curriculum requirements and classroom realities. The impact is both cognitive (reduced understanding) and affective (loss of interest). It aligns with Vygotsky’s theory of experiential learning, which emphasizes that learners understand best through hands-on practice.

4.2.4. How prepared and skilled are your Physics teachers in handling electronic practical lessons?

Two of the heads acknowledged that teachers lacked adequate preparation in electronic practicals.

Head 1 noted: “Our teachers are well-trained in theory, but practical exposure is minimal.” **Head 2 emphasized:** “They are competent in general science but weak in handling electronic experiments.”

Head 3 added: “Some teachers shy away from practicals because they fear damaging the little equipment we have.”

This reflects gaps in teacher preparedness. The findings align with studies by Gudyanga (2021), who observed that lack of technical training among teachers in rural schools hinders science delivery.

4.2.4 Support systems (e.g., workshops, in-service training) have been provided for teacher developmenT

Heads reported that professional support was minimal.

Head 1 said: “Workshops are rare; the last one on practicals was five years ago.”

Head 2 added: “Teachers rely on peer-sharing during cluster meetings, but this is not enough.”

Head 3 stated: “We have never received specific training on electronic practicals.”

This lack of continuous development reflects systemic neglect. The responses confirm findings by UNESCO (2018), which highlighted the absence of structured professional development for rural science teachers in Zimbabwe.

4.2.5 What types of digital/electronic resources are available for teaching Physics practicals at your school?

Heads reported scarce resources. Head 1 said: “We only have computers for ICT, not for Physics.” Head 2 added: “There is no internet connection in our science block.” Head 3 noted: “We sometimes borrow calculators from Mathematics, but that is the extent of digital resources.” These responses show a stark absence of Physics-specific digital resources. The findings confirm Nyikahadzoi (2019), who observed that digital tools in rural Zimbabwean schools are rarely integrated into science teaching.

4.2.6. What challenges limit the effective use of these resources?

Heads cited unreliable electricity and lack of teacher skills. Head 1 explained: “Even when we get a projector, power cuts render it useless.” Head 2 added: “Teachers lack confidence in using ICT for practicals.” Head 3 noted: “Resources are locked away because we fear theft or damage.” These barriers reflect both technical and managerial challenges. They align with Mutasa (2020), who noted that in rural contexts, digital resources are often present but underutilized due to systemic barriers.

9. How does the school fund the procurement and maintenance of Physics practical equipment?

Funding was described as minimal. Head 1 said: “We rely mainly on school development funds from parents.” Head 2 added: “Government grants rarely cover practical equipment.” Head 3 emphasized: “We sometimes get donations, but these are not reliable.” This indicates schools operate under severe financial constraints. It reflects findings by Mpofu (2020), who observed that rural schools depend heavily on parental contributions, which are limited by poverty.

What role do government policies or educational directives play in influencing the delivery of electronic practical lessons?

Heads expressed frustration with policy gaps. Head 1 said: “Government talks about STEM, but there is no equipment sent to rural schools.” Head 2 added: “Policies exist on paper but are not implemented.” Head 3 stated: “The STEM drive seems to benefit urban schools more than us." This suggests a mismatch between policy rhetoric and rural realities. The findings align with Sibanda (2019), who argued that STEM policy implementation in Zimbabwe favors urban institutions.

11. How does the local community (parents, local leadership, NGOs) contribute to supporting electronic practical education?

Heads reported minimal community support. Head 1 said: "Parents contribute small levies, but most are unemployed." Head 2 added: "The community values education, but financial support is lacking." Head 3 noted: "Local NGOs sometimes donate textbooks, but never electronic equipment." This reflects rural poverty's impact on education. The findings confirm Nyathi (2021), who showed that rural communities in Zimbabwe lack capacity to fund high-cost science projects.

12. What strategies do you think could improve the implementation of Physics electronic practicals in rural schools like yours?

All heads proposed government-led interventions. Head 1 said: "Government should provide mobile science labs for rural schools." Head 2 suggested: "More teacher training workshops are needed." Head 3 added: "Partnerships with NGOs and private companies could help." These strategies highlight both top-down (policy-driven) and bottom-up (community-driven) solutions. They align with Gudyanga (2021), who recommended collaborative approaches to strengthening rural science education.

Section B: Teachers' Interviews

4.3.1 Resources are available for conducting electronic practicals

The teachers admitted that resources were extremely limited.

Teacher D said: "We have only one voltmeter and a few resistors, which are often not functional."

Teacher B added: "Sometimes I improvise with old radio parts to demonstrate simple circuits."

Teacher E noted: "We lack oscilloscopes or signal generators, which are key for electronics."

These responses highlight the scarcity of specialized equipment. The researcher notes that improvisation is a coping strategy, but it risks inaccuracies in scientific understanding. This reflects Mushayabasa (2018), who found that improvisation in rural Zimbabwe often compromises the quality of practical learning in science.

4.3.2. How often are learners exposed to actual electronic experiments in your classroom

Teachers revealed that exposure is very minimal. Teacher A admitted: “We mostly teach electronics theoretically; practicals happen only once or twice a term.” Teacher C noted: “Students only do experiments near exam time.” Teacher D added: “We simulate practicals by drawing circuit diagrams on the chalkboard.” The responses reveal that learners’ exposure is delayed and minimal, creating a gap between curriculum intent and practice. Researcher analysis indicates that this minimal exposure limits learners’ practical competence. According to Vygotsky’s experiential learning theory, practical engagement is essential for internalizing concepts, yet rural learners are deprived of this opportunity.

4.3.4 Challenges faced in conducting these practicals

The challenges cited included inadequate resources, lack of training, and poor infrastructure. Teacher B said: “We cannot conduct proper practicals because apparatus is missing.” Teacher C added: “Even when we plan for practicals, electricity is unreliable.” Teacher E stated: “Large class sizes make it difficult to manage experiments.” The responses highlight systemic barriers. The researcher’s analysis suggests that these challenges reflect both structural issues (infrastructure, equipment) and pedagogical limitations (teacher skill, classroom management). These findings confirm Mutasa (2020), who argued that rural science teaching is restricted by systemic constraints beyond teacher control.

4.3.5 How lack of resources affects learner performance in Physics?

Teachers agreed that the lack of resources negatively impacts learner performance. Teacher A said: “Learners fail to apply theoretical knowledge because they lack practical experience.” Teacher D noted: “Examination questions on electronics practicals always challenge them.” Teacher B added: “Many learners avoid Physics at A-Level because they feel it is too abstract.” The researcher interprets this as evidence of a vicious cycle: lack of exposure leads to poor exam performance, which reduces student motivation and progression. This resonates with Chikomba (2020), who observed that poor performance in rural science subjects is directly linked to limited practical exposure.

4.3.6 Teaching methods used to compensate for the absence of proper equipment

Teachers relied on alternative methods.

Teacher C said: “I use chalkboard drawings and verbal explanations.”

Teacher E explained: “I encourage group discussions and problem-solving instead of experiments.”

Teacher B added: “Sometimes I improvise using locally available materials like dry cells and wires.”

These methods show creativity but fall short of providing authentic laboratory experience. Researcher analysis indicates that while improvisation builds resilience, it cannot replace authentic experimentation. This finding supports Nyikahadzoi (2019), who argued that pedagogical innovation cannot fully overcome the gap left by inadequate laboratory infrastructure.

4.3.7 What support systems have you received (e.g., workshops, professional development) to improve your practical teaching skills?

Teachers confirmed a lack of consistent professional development. Teacher B said: “We attended one cluster workshop years ago, but it was too general.” Teacher C added: “There is no specific training for electronic practicals.” Teacher D emphasized: “We rely on self-learning, sometimes reading old textbooks.” The findings suggest a professional development gap in rural contexts. The researcher interprets this as evidence that the professional development system in Zimbabwe is uneven and urban-biased. This is supported by Sibanda (2019), who noted that rural teachers are often excluded from targeted STEM training programs.

4.3.8 How could the delivery of Physics electronic practicals be improved in rural schools

Teachers proposed several solutions. Teacher E said: “Government should provide at least basic electronics kits to every rural school.” Teacher C added: “Workshops for teachers must be frequent and practical-based.” Teacher A emphasized: “Partnerships with NGOs could bring in mobile science labs.” The responses indicate a desire for systemic support. Researcher analysis shows that teachers are aware of potential interventions but lack agency to implement them. This aligns with Gudyanga (2021), who recommended multi-stakeholder approaches to strengthening rural science education.

Section C: Observation Findings

4.4.1 Availability and Condition of Laboratory Facilities

The observations revealed that none of the three rural schools had a fully functional Physics laboratory. At School A, a storeroom was converted into a multipurpose “lab,” with broken stools and outdated wooden benches. School B used an ordinary classroom with no sinks, gas taps, or proper workstations. School C had a laboratory building, but it lacked equipment and water supply. These findings suggest that the label “laboratory” in rural schools often denotes a space, not functionality. The researcher interprets this as evidence of infrastructural neglect in rural education. This aligns with Chireshe (2020), who observed that rural schools in Zimbabwe are often equipped with buildings that do not meet laboratory standards, undermining the curriculum’s emphasis on practical science.

4.4.2 Presence and Reliability of Electricity Supply

Observation revealed inconsistent electricity supply in all three schools. School A had frequent power cuts lasting several hours, while School B lacked electricity altogether and relied on paraffin lamps for evening study sessions. School C had solar panels installed by an NGO, but the system could not power heavy laboratory equipment. The unreliable energy supply severely limited the possibility of conducting electronic experiments. Researcher analysis indicates that electricity is a prerequisite for modern Physics practicals, and without it, electronic topics remain abstract. This finding supports UNESCO (2019), which emphasized that lack of reliable electricity is a major barrier to STEM education in rural Africa.

4.4.3. Evidence of Teachers Demonstrating Electronic Practical Experiments

During observed lessons, none of the teachers conducted full-scale electronic experiments. At School A, the teacher explained Ohm's Law using chalkboard sketches instead of actual apparatus. At School B, the teacher displayed a single dry cell and wires but could not complete the circuit due to missing components. School C's teacher attempted to demonstrate resistance in series and parallel using improvised bulbs, but the connections failed midway. The absence of hands-on demonstrations shows a reliance on theory-based teaching. Researcher analysis reveals that this undermines experiential learning, a critical pillar of science education. This resonates with Bruner's discovery learning theory, which stresses that learners internalize concepts more effectively through direct manipulation of materials.

4. Level of Student Involvement in Handling Electronic Practical Tools

Student involvement was minimal. In School A, learners merely copied diagrams from the chalkboard into their notebooks. At School B, two students tried connecting a simple circuit, but the attempt failed due to faulty wires. At School C, the teacher did not allow learners to handle apparatus, citing "fragile equipment." As a result, students were passive recipients rather than active participants in practical lessons. The researcher interprets this as a lost opportunity for skill acquisition, since manipulative skills develop only through practice. This aligns with Gudyanga (2021), who found that rural students often lack confidence in national exams because they never handle apparatus during school lessons.

4.4.3 Availability and Actual Use of Digital/Electronic Resources

Observations confirmed the absence of digital resources such as oscilloscopes, signal generators, or simulation software. At School A, the only available resource was an outdated multimeter, which was locked away "to prevent damage." School B and C had no computers in the lab, although School C had a small computer room with offline e-learning modules unrelated to Physics. The actual use of digital resources was therefore nonexistent. Researcher analysis reveals that while the national curriculum emphasizes ICT integration, the rural context makes this aspiration impractical. This confirms Mutasa (2020), who argued that the digital divide between rural and urban schools continues to widen, particularly in STEM subjects.

6. Evidence of Community or Government Support

Observation revealed very little evidence of structured community or government support. At School A, a broken circuit board kit had been donated by a local councilor years ago, but it was no longer functional. At School B, parents had contributed small levies, which were spent on basic school maintenance rather than laboratory equipment. School C had received solar panels from an NGO, but no direct science-related resources. This shows a lack of targeted support for Physics practicals. Researcher analysis indicates that community contributions are often misaligned with the actual needs of science education. This finding is supported by Nyathi (2021), who noted that rural education initiatives in Zimbabwe often lack focus, leaving critical areas like science practicals underfunded.

4.5 Discussion of Findings

4.5.1 Objective 1: To assess the availability and adequacy of infrastructure for Physics electronic practicals in rural secondary schools

The findings revealed a general lack of functional laboratory infrastructure in the three sampled schools. Although two schools had buildings designated as laboratories, these were poorly maintained and lacked running water, gas taps, and adequate workstations. In one case, a storeroom was converted into a makeshift laboratory, reflecting how the idea of a laboratory is often symbolic rather than functional. This aligns with Chireshe (2020), who observed that rural schools in Zimbabwe often possess the physical structures of laboratories without the essential equipment needed to support practical teaching.

The inadequacy of laboratory facilities undermines the experiential learning emphasized in science education. According to Hofstein and Lunetta (2004), laboratories are not just spaces for experiments but also contexts for inquiry, problem-solving, and the development of manipulative skills. In the studied schools, the absence of such facilities reduced Physics practicals to chalkboard illustrations. Similar findings were reported by Oginni and Owolabi (2012) in Nigeria, where poor laboratory infrastructure resulted in rote learning of scientific concepts.

The researcher therefore concludes that infrastructure deficiencies significantly compromise the quality of Physics electronic practicals in rural schools, leaving learners disadvantaged compared to their urban counterparts who often have access to better-equipped laboratories.

4.5.2 Objective 2: To establish the preparedness of teachers to deliver Physics electronic practical lessons

Teacher interviews indicated that while teachers were qualified to teach Physics, they expressed limited confidence in conducting electronic practicals due to insufficient training and exposure. Most had not attended recent professional development workshops, and their attempts at demonstrations were constrained by inadequate apparatus. For instance, one teacher described relying solely on chalkboard sketches to explain Ohm’s Law.

This finding supports the work of Gudyanga and Jita (2018), who argued that teacher competence in practical subjects is not only a function of academic qualification but also of continuous professional development. Without in-service training and access to equipment, teachers may default to theoretical instruction, which contradicts the objectives of competency-based curricula. Similarly, Abrahams and Millar (2008) emphasized that practical work is most effective when teachers are both conceptually and procedurally competent. Thus, while the teachers in this study demonstrated commitment, their lack of training and hands-on exposure to electronic experiments hindered their ability to deliver effective lessons. This gap reflects a systemic issue where rural teachers are not adequately supported to meet the demands of a modernized science curriculum.

4.5.3 Objective 3: To examine the availability and utilization of digital/electronic resources for Physics practicals

Observation findings confirmed that digital resources such as oscilloscopes, simulation software, or signal generators were largely absent. Even when basic resources like multimeters were available, they were often locked away and not used during lessons. Teachers reported fears of damaging fragile equipment or not knowing how to use advanced tools.

This aligns with Mutasa (2020), who documented how the digital divide continues to disadvantage rural learners in Zimbabwe, particularly in STEM subjects. Internationally, OECD (2016) noted that the mere availability of ICT resources does not guarantee their use; teachers' confidence and institutional culture strongly influence integration. In the present study, the absence of training and limited access meant that electronic and digital tools were underutilized, reinforcing theoretical over practical learning.

The researcher interprets this as a reinforcement of inequality: while urban learners are exposed to simulations and modern laboratory equipment, rural learners face examinations without adequate exposure to tools required for mastery. This perpetuates what Spaull (2013) described as the “two-tier education system” common in many African contexts.

Objective 4: To explore the role of funding and policy in supporting electronic practical lessons

School heads reported that funding for laboratories and equipment was primarily sourced from school levies, with little targeted government or NGO support. This explains why levies were diverted to pressing needs like classroom maintenance, leaving laboratories underfunded. Furthermore, while government curriculum policies emphasize the importance of practical work, there was no evidence of systematic funding to match these expectations.

This confirms Nyathi (2021), who found that rural schools in Zimbabwe often receive policy directives without the corresponding material support to implement them. The situation mirrors findings in Uganda (Muwanga, 2019), where universal secondary education policy expanded access but did not provide adequate resources for science teaching. The disjuncture between policy rhetoric and funding reality undermines the feasibility of electronic practicals in rural contexts. The researcher therefore argues that unless deliberate funding mechanisms are established, electronic practicals will remain aspirational rather than achievable in rural schools.

Objective 5: To examine the role of the community and other stakeholders in supporting Physics electronic practicals

.Findings revealed minimal community involvement in supporting science education. At best, parents contributed levies, but these were insufficient to meet laboratory demands. In one school, solar panels were donated by an NGO, but these addressed general electricity needs rather than the specific requirements of a Physics laboratory. Teachers noted that community stakeholders valued visible projects like classrooms or toilets more than laboratory resources, reflecting a mismatch between community priorities and academic needs.

This is consistent with Mapfumo (2019), who highlighted that rural communities often lack awareness of the importance of investing in science education, focusing instead on immediate infrastructural needs. Similarly, Okeke and Ofoegbu (2012) observed that in Nigeria, community contributions to education were more effective when guided by targeted government partnerships.

The researcher concludes that while community support exists in principle, it is not strategically aligned with enhancing Physics electronic practicals. This underscores the need for sensitization and structured partnerships to direct community resources toward science education priorities.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents the conclusions drawn from the study, which explored the challenges and possibilities in delivering Physics electronic practicals in rural secondary schools in Zimbabwe. The conclusions are based on the findings outlined in Chapter Four and interpreted in light of relevant literature. The chapter also provides recommendations for practice, policy, and further research. Finally, the study reflects on its contribution to knowledge and implications for improving science education in rural contexts.

5.2 Summary of the Study

The study set out to investigate the challenges hindering the effective delivery of Physics electronic practicals in rural secondary schools. Specifically, it sought to assess the adequacy of infrastructure, examine teacher preparedness, explore the availability of digital and electronic resources, analyze the role of funding and policy, and investigate the involvement of the community and other stakeholders.

A qualitative research design was adopted. Data were collected from three school heads through questionnaires, five Physics teachers through semi-structured interviews, and classroom/laboratory observations conducted by the researcher. The triangulation of these instruments allowed for a nuanced understanding of the lived experiences of educators and learners in rural schools.

The findings revealed that laboratories were either non-functional or poorly equipped, teachers had limited professional development opportunities, digital resources were scarce and underutilized, funding was inadequate and unsystematic, and community involvement in supporting science education was minimal. These challenges collectively undermine the effective teaching of Physics electronic practicals in rural schools.

5.3 Conclusions

5.3.1 Infrastructure

The study concludes that rural secondary schools lack adequate infrastructure for Physics electronic practicals. Laboratories, where available, are symbolic rather than functional, often lacking running water, sufficient workstations, or electricity stability. This compromises the experiential learning central to science education (Hofstein & Lunetta, 2004).

5.3.2 Teacher Preparedness

Teachers in rural schools, although academically qualified, are not adequately prepared to deliver electronic practicals due to lack of training and exposure. Professional development opportunities are rare, resulting in an overreliance on theoretical teaching and chalkboard illustrations. This undermines the competency-based approach promoted by curriculum reforms (Abrahams & Millar, 2008).

5.3.3 Digital and Electronic Resources

Digital and electronic teaching resources such as oscilloscopes, simulation software, and multimeters are largely absent in rural schools. Where available, they are underutilized due to fear of damage or lack of technical know-how. This widens the digital divide between rural and urban learners, creating unequal learning outcomes.

5.3.4 Funding and Policy

The study concludes that while national policies emphasize practical learning, there is a lack of financial backing to support this vision. Rural schools rely heavily on school levies, which are insufficient to cover laboratory equipment costs. The disjuncture between policy and resource provision renders electronic practicals more aspirational than achievable.

5.3.5 Community and Stakeholder Engagement

Community involvement in supporting Physics electronic practicals is minimal. While parents contribute through levies, they prioritize visible infrastructure projects such as classrooms and toilets over laboratories and equipment. This reflects a lack of awareness of the importance of science education in community development.

5.4 Recommendations

5.4.1 Recommendations for Practice

1. Teacher Professional Development: Continuous professional development programs focusing on electronic practicals should be organized for Physics teachers. Workshops, in-service training, and peer-support systems should be prioritized.

2. Utilization of Low-Cost Alternatives: Teachers should be encouraged to improvise using low-cost locally available materials while awaiting full laboratory resourcing. For example, simple circuits using dry cells, bulbs, and wires can still promote hands-on learning.

3. Integration of ICT: Schools should explore affordable ICT solutions such as free online simulation software (e.g., PhET) to supplement limited resources.

5.4.2 Recommendations for Policy

Targeted Funding: The Ministry of Primary and Secondary Education should establish specific grants for science laboratory development in rural schools, rather than relying on general school levies.

2. Policy Alignment with Resources: National curriculum policies should be matched with deliberate investments in teacher training, laboratory infrastructure, and digital resources.

5.4.3 Recommendations for Community and Stakeholders

Awareness Campaigns: Communities should be sensitized about the importance of investing in science education, particularly laboratories and electronic resources.

Local Resource Mobilization: School Development Committees (SDCs) should explore partnerships with local industries and councils to mobilize resources for laboratories.

5.5 Recommendations for Further Research

A comparative study between rural and urban schools on the delivery of Physics practicals to highlight equity gaps.

An investigation into the effectiveness of improvised teaching resources in enhancing Physics learning outcomes in resource-constrained contexts.

3. A study exploring the role of ICT simulations in bridging laboratory gaps in rural schools.

4. A policy analysis of how Zimbabwe’s education funding framework affects science education delivery in disadvantaged areas.

5.7 Conclusion

The study concludes that Physics electronic practicals in rural Zimbabwean schools are hindered by a constellation of interrelated challenges: inadequate infrastructure, poorly prepared teachers, limited resources, insufficient funding, and weak community support. These challenges collectively perpetuate educational inequalities between rural and urban learners. Addressing them requires deliberate and coordinated action from government, schools, communities, and external partners.

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APPENDIX

Appendix A Questionnaire for School Heads

Section A: School Profile

1. Please describe your school in terms of size, location, and available science facilities.

2. How many Physics teachers do you have, and how many students take Physics at Ordinary Level?

Section B: Infrastructure

3. What facilities does your school currently have to support Physics electronic practical lessons?

4. In what ways does the adequacy or inadequacy of this infrastructure affect lesson delivery?

Section C: Teacher Preparedness

5. How prepared and skilled are your Physics teachers in handling electronic practical lessons?

6. What support systems (e.g., workshops, in-service training) have been provided for teacher development?

Section D: Digital Resources

7. What types of digital/electronic resources are available for teaching Physics practicals at your school?

8. What challenges limit the effective use of these resources?

Section E: Funding and Policy

9. How does your school fund the procurement and maintenance of Physics practical equipment?

10. What role do government policies or educational directives play in influencing the delivery of electronic practical lessons?

Section F: Community Engagement

11. How does the local community (parents, local leadership, NGOs) contribute to supporting electronic practical education?

12. What strategies do you think could improve the implementation of Physics electronic practicals in rural schools like yours?

Appendix. B: In-Depth Interview Guide for Teachers

1. Could you describe your experiences in teaching Physics electronic practicals at Ordinary Level?
2. What type of infrastructure is available for you to use, and how does this affect your lessons?

3. How would you describe your own level of preparedness and training in handling electronic practicals?
4. What challenges do you face when trying to integrate electronic practicals into your teaching?
5. What digital or electronic resources do you have access to, and how do you use them in your lessons?
6. What barriers prevent you and your students from making effective use of these resources?
7. How do financial limitations affect your ability to carry out electronic practical lessons?
8. In what ways do government policies or curriculum requirements shape how you conduct practicals?
9. How does the local community influence the teaching and learning of electronic practicals in your school?
10. In your opinion, what measures could improve the teaching and learning of Physics electronic practicals in rural schools?

Appendix C Observation Checklist

Infrastructure

1. Availability and condition of laboratory facilities (dedicated lab vs. Ordinary classroom).
2. Presence and reliability of electricity supply (including alternatives like solar).

Teacher Practice

3. Evidence of teachers demonstrating electronic practical experiments during lessons.

Student Participation

4. Level of student involvement in handling or engaging with electronic practical tools.

Digital Resources

5. Availability and actual use of electronic/digital resources (e.g., computers, multimeters, oscilloscopes, internet, software).

Community/Government Influence

6. Visible evidence of support from community or government (e.g., donated equipment, resource mobilization, policy materials).