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AN ASSESSMENT OF FACTORS AFFECTING THE TEACHING AND LEARNING OF “O” LEVEL PHYSICS PRACTICAL WORK

BY

MILLICENT CHAURAYA

B1543315

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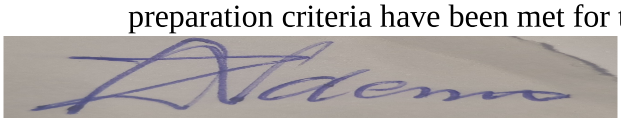

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Name of Student: Millicent Chauraya

Registration Number: B1543315

Dissertation Title: An assessment of factors affecting the teaching and **learning of "O" level physics practical work.**

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Signed ……………………………………………………

Date 12/09/23

Permanent address:
14821 Budiriro 5 B , Harare
Contact Details
Cell number +263773896892
Email Address chaurayamillicent@gmail.com

DECLARATION

I Millicent Chauraya, **B1543315** do hereby declare that this research represents my work, and has not been written for me or published by others for any degree programme or publications. All the materials used in this study have been fully acknowledged and sited accordingly in the study as will be shown in the reference and appendices at the end of the research study.

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DEDICATIONS

This research work is dedicated to my brother Mr A. Shonhiwa and his wife for all the parental support and my family at large.

LIST OF ABBREVIATIONS

AR- Augmented reality

EOI- Expert Opinion Interviews (EOI)

IBL- Inquiry-based learning (IBL)

PAL- Peer-assisted learning (PAL)

PCK- Pedagogical content knowledge (PCK)

ZIMSEC- Zimbabwe School Examination Council

ABSTRACT

The study sought to make an assessment of factors affecting the teaching and learning of “O” level physics practical work. The study objectives were to ascertain how much secondary school physics instructors and students were aware of the benefits of including practical work into instructions. Secondly, to determine barriers that prevented teachers and students from doing practical work effectively for teaching and learning. Lastly, to suggest solutions to the problems teachers and students faced while attempting to implement the proper use of practical work in teaching and learning. The researcher adopted an interpretivism philosophy and a case study design was used in the study. The researcher used 1 focus group discussion which had a total of 11 participants, interviews (3 teachers and 1 head of department) and documentary analysis. The study found among others that hands-on learning experiences in physics had a wide range of benefits for students which included improved understanding, retention, critical thinking and motivation. The study found that although teachers were specialized in physics, they had less experience in the teaching of the subject and the majority had diplomas and needed to upgrade. Overall, it was found that limited resources and equipment, time constraints, lack of teacher training and support, safety concerns, limited student engagement and motivation, limited access to technology, and limited funding. Additionally, the study established that technology provided visual aids and simulations which helped learners understood complex concepts. It was found that traditional lectures and hands-on experiments, virtual simulations, and project-based approaches were all effective methods for teaching practical work in physics. Traditional methods helped students understand concepts and apply them in real-world situations, while those virtual simulations allowed students to experiment with different scenarios and see results in real-time. Among several recommendations, the study recommended government through the Ministry of primary and secondary education to mobilize funds towards resources needed in the teaching and learning of physics practical work in secondary schools.

Key words: *physics practical work, assessment, factors, teaching and learning, ‘O’ level.*

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CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter marks the beginning of research carried out on the assessment of factors affecting the teaching and learning of physics practical work. It has been a substantive feature of the work of the science education research in the community for the past years. Here the researcher seeks to assess the factors affecting teaching and learning of physics practical work. This chapter will focus on the background of the study, problem statement, objectives, research questions, significance of the study, delimitations, limitations and summary of the chapter.

1.2 Background of the study

Due to poor performance in physics practical work in ordinary level, the researcher decided to carry out a comprehensive study to assess the likely causes of this wanting performance and its possible remedies by using terminal examinations results from three local schools in physics and collecting information from teachers and students. There has been performing poorly mostly in practical work for the last five years since new curriculum has been introduced which encourage students to write the practical examination instead of alternative to practical. The internal examinations, which are formative examinations, have a bearing to the student's performance to the national examinations, Zimbabwe School Examination Council (ZIMSEC) that are taken at the end of the course as summative examination. Results of ordinary level from four schools in the cluster were taken and showed a significant drop from the past 3 years as shown in table 1.1 below

Table 1.1: Physics Results from four schools from 2019 to 2022

Cluster Schools	Results year 2019 (%)	Results year 2020 (%)	Results year 2021`(%)	Results year 2022 (%)
Nyazura High School	89.3	85.5	80	84.8
Vengere High School	65.3	70.1	69	65.3
Mavhudzi High School	56.6	60	62.7	60.3
Kriste Mambo Girls High	86	83.3	85	82.6

Without experimentation, physics studies are incomplete, but if we look back a few years, we will notice that physics was primarily taught in secondary schools as a body of theoretical information, with little to no emphasis on practical work approaches to teaching and learning physics (Ramnarain, 2011). According to (Kargbo A, 2021), "as far as science is concerned, experimentation is always exploratory or perhaps it would be more accurate to say information seeking. Experiments carried out to learn new things, validate predictions and check the reliability of other people's claims. Prior researchers have argued that teaching through practical work can motivate learners' self-learning and powerfully grasp sciences, especially physics (Reiss & Abrahams , 2018). Learners may act in diverse ways in a similar educational system based on the practical work done in their learning. Practical work embraces different activities like a laboratory experiment, project work, library research, fieldwork, place visits, environmental monitoring, and investigating technologies (Vilaythong, 2019). For that reason, practical work should be conducted in different areas without restricting it to the classroom or laboratory. Since practical work is one of the teachings and learning methods that obliges learners' participation rather than passive with the confidence of doing practices (Babalola, 2017). Therefore, learners may autonomously be engaged in teaching and learning activities through observation and the problems they have asked and responses provided.

Moreover, practical work or hands-on learning in physics is largely striving to produce learner who has ability and capability of hearing, manipulating and observing the expected outcomes (Maponya & Kibirige , 2021). Unfortunately, students in some secondary schools are not given the opportunities to manipulate the materials and participate actively in doing practical work to prevent them from damaging the limited equipment available. Therefore, learners have to follow teacher demonstrations in the actual classroom setting in what Motlhabane (2019) called "theoretical-practical", which is the teaching of the supposed practical activities theoretically in the classroom instructions. The digital technology that is predominating the current economy requires that the learners are well-trained in practical work-related skills. However, teaching practical work theoretically is a hopeless and poor teaching and learning approach in the current world that does not foster creativity and innovation of useful academic technological tools such as ICT to enhance and develop today's academic endeavors and the world (Serdyyukov, 2017). Science and technology have led to the transformation of the world (Steenhuis &De Bruijn, 2020). The uniqueness of science education is that it involves practical work (Reiss & Abrahams , 2018). The effectiveness of teaching and learning physics in secondary schools depends on the extent to which practical works are inserted and implemented. Generally, physics is considered as the heart of all technology. This explains the fact that physics controls all forms of technology (Harcourt, 2018). For the effective teaching and learning of physics practical, there are several things, which need to be considered. The researcher sought to assess the factors affecting the teaching and learning of physics practical work and potential solutions.

1.3 Problem statement

Practical work is an important component of the teaching and learning of physics. The competence-based curriculum requires that students write a practical examination at the end of their course. This is a shift from the alternative to practical work examination. It becomes mandatory therefore, that students do practical work at least once a week during the course of their learning. The study is aimed at assessing the factors affecting the teaching and learning of level physics practical work

1.4 Objectives

The aim of this study is to assess the factors that affect the teaching and learning of physics practical. Following are specific objectives of this study;

1. To ascertain how much secondary school physics instructors and students are aware of the benefits of including practical work into instructions.
2. To determine what barriers, prevent teachers and students from doing practical work effectively for teaching and learning.
3. To suggest solutions to the problems teachers and students face while attempting to implement the proper use of practical work in teaching and learning.

1.5 Research questions

1. What are the benefits of incorporating practical work in the teaching and learning of physics?
2. What are the factors affecting the teaching learning of physics practical work?
3. What methods could be used to enhance the use of practical work in secondary school physics teaching and learning?

1.6 Assumptions

1. The researcher will be able to find enough resources both material and financial to carry out the research
2. All the information given by participants will be true and reflect the reality on the ground
3. There will be maximum cooperation both in learners and in teachers

1.7 Significance of the study

This study aims to pinpoint some of the key elements that influence both the teaching and learning of physics practical. The researcher intends to discover these factors and then suggest viable remedies to lessen the prevalence of such problems. The work is hoped to aid future academic who might be interested in pursuing research in this field. The researcher expects that the project would help teachers get more familiar with physics practical challenges. In addition, it will be helpful to educators dealing with same issue in the fields of Chemistry, Biology and

Agricultural sciences. Students will also learn where to focus their attention in order to enhance their study and learning. Finally, this research will advise educational planners and administrators on the steps that need to take place to give kids a progressive education.

1.8 Delimitations of the study

The study focused on the factors affecting the teaching and learning of physics at three schools only and only 30 students are being sampled and cannot give a conclusion from few students. Time of the research was from the period of January 2023 to July 2023 this can hinder to come up with the reliable information. Other schools nearby or even in the country were not covered due to the short period of the study.

1.9 Limitations of the study

Time allocated for the project was the major limiting factor since this was done concurrently with teaching, so the researcher was to utilize her own time apart from the time attach to her teaching. In addition, lack of funds was another hindrance, as it proved difficult to cater for printing expenses in order to conduct the research.

1.10 Definition of terms

1.10.1 Practical work: It is work in which student interact with materials or with secondary sources of data to observe an understand the material world

1.10.2 Physics practical: These are activates conducted with the aid of physics apparatus to either discover a fact or verify fact in a class or room or laboratory

1.10.3 Physics teacher: The teacher that teaches physics

1.10.4 Students: This referred to pupils in the secondary school that are in the physics class.

1.11 Summary

The chapter focused on the introduction of the research topic, the background of the study, statement of the problem, objectives and significance of the study, limitations and delimitations of the study. The next chapter the researcher presented literature review.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

The literature review chapter lies at the heart of any academic research as it provides the context for the study by exploring existing research on the topic. A literature review chapter synthesizes existing literature and sheds new light on the research problem, giving the reader a comprehensive view of the research landscape. Additionally, it helps researchers to identify gaps in the literature and develop a research question and hypothesis that are worthy of further study. In order to conduct an effective literature review, the researcher will identify relevant sources (Cook, 2014). Furthermore, the literature review will be conducted in a critical, analytical and objective manner. It will therefore provide 'rich descriptions' of the contribution of literature reviewed and make the connection between the reviewed literature and the current research (Kohler-Rausch & Rausch, 2019) This literature review chapter will examine factors affecting the teaching and learning of physics practical work in secondary schools. The chapter unfolds by giving the theoretical framework, the conceptualization of key terms, literature on the objectives of the study, empirical evidence, research gap analysis and a conclusion will be given at the end.

2.2 Theoretical Framework

2.2.1 Constructivist Theory

Constructivism is a learning theory which emphasizes that people actively construct meaning by building knowledge through experiences and interactions with the world around them. The theory is commonly associated with the works of Jean Piaget, Lev Vygotsky and John Dewey (Jones & Brader-Araje, 2020). According to Piaget, learners create their understanding by organizing and constructing their knowledge through experiences in their environment. Piaget's theory of cognitive development postulated that individuals go through stages of development, and that knowledge is constructed through active interaction with the environment (Kahveci &

Aydin, 2019). Vygotsky's sociocultural theory of constructivism posits that knowledge is collaborative in nature, and is constructed through interactions with more knowledgeable individuals, such as teachers or peers (Fosnot, 2020). Vygotsky believed that cognitive development is connected to social interactions, and that language also plays a critical role in the development of knowledge. Dewey, on the other hand, believed that knowledge is constructed through active and experiential learning (Journell & Collier-Meek, 2019). He emphasized the importance of learning by doing, and stressed the need for education to connect to real-life situations. In conclusion, constructivism as a learning theory highlights the individualized nature of learning, and emphasizes that learners actively construct meaning and knowledge through interaction with their environment, peers, and educators. It is therefore important for educators to create learning environments that support active inquiry, collaboration, and experimentation in order to maximize the learning experience of students (Golshani et al., 2023).

Constructivism theory greatly informs the study on factors affecting the teaching and learning of physics practical work in schools. According to this theory, learning occurs when individuals actively construct their own understanding of their environment, rather than passively receiving information. Therefore, students learn more effectively when they are actively involved in the learning process by engaging in hands-on explorations or practical work. In relation to physics practical work, constructivism theory suggests that when students are engaged in constructing their own understanding of tasks or concepts, they are more likely to internalize the knowledge and be able to apply it in other contexts. This means that the traditional approach of teacher-centered instruction where students watch demonstrations and listen to lectures is not sufficient. Instead, students need to be actively engaged in practical work, where they can manipulate apparatus, perform experiments, and make observations. Therefore, the researcher seeks to use this theory to gauge factors affecting the teaching and learning of physics practical work.

2.3 Conceptual Literature

2.3.1 Teaching

According to Hofer and Pintrich (2019), teaching can be conceptualized as a process of facilitating learning by creating an environment that supports the acquisition of knowledge, skills, values, and attitudes. It involves the provision of resources, strategies, and opportunities for students to construct their understanding of a subject matter through active engagement in learning activities. Teaching also entails the use of various instructional techniques such as questioning, feedback, and assessment to guide students towards achieving the desired learning outcomes (Richards & Farrell, 2023). Effective teaching involves the ability to tailor instruction to students' individual differences, motivations, and learning styles, as well as to adapt to changing educational contexts and technological advancements (Hennessy, Joshi, & Sivapalan, 2021). The researcher seeks to find out factors limiting the teaching of physics practical work in secondary schools at ordinary level.

2.3.2 Learning

According to Huitt and Hummel (2019), learning can be conceptualized as a relatively permanent change in behavior or mental processes resulting from experience or training. It involves several cognitive, emotional, and social processes that lead to the acquisition of new knowledge, skills, values, and attitudes. Learning can occur through various methods, including observation, practice, and instruction, and is influenced by personal factors such as motivation, interest, and prior knowledge. The researcher seeks to find out factors affecting the learning of physics practical subject at ordinary level in secondary schools.

2.3.3 Factors

Factors can be conceptualized as elements or circumstances that influence a situation, outcome or decision. According to Hennessy, Joshi, and Sivapalan (2021), factors can be both internal and external, and they can have positive or negative effects on outcomes. In educational settings, factors such as student motivation, teacher competence, and classroom environment have been found to influence student performance and achievement (Richards & Farrell, 2023). The researcher seeks to find socio-economic factors, learner's attitude, peer influence and institutional variables that affect the teaching and learning of physics practical work at ordinary level in secondary schools.

2.3.4 Physics practical work

Physics practical work is a critical aspect of the study of physics. Practical work in physics encompasses a range of hands-on activities or experiments designed to help students understand physical concepts and principles in a practical context. The aim of physics practical work is to enable students to apply theoretical knowledge they have acquired in class to the real world. Physics practical work can be done using a variety of materials and equipment, and it can take place indoors, outdoors, or in laboratory settings.

One of the primary goals of physics practical work is to enhance the learning process. Practical work helps connect theoretical concepts to practical applications in real-world conditions, which can aid in the retention of knowledge. Additionally, physics practical work allows for exploration, experimentation and discovery learning, which can be an effective way to engage students in the learning process (Davis, Tiska, & Ghaedian, 2019). Through practical work, students can see the relevance and value of their learning in real-world contexts. Practical work also provides opportunities for students to develop critical thinking skills, problem-solving skills, and scientific inquiry skills. Thus, physics practical work is an essential component of physics education. Several studies have explored the factors affecting physics practical work in schools.

In their study, Hennessy, Joshi, and Sivapalan (2021) identified several factors that affect the teaching and learning of physics practical work in schools. These factors include the quality of lab materials, the availability of lab equipment, the proficiency of the teacher, the level of support from administrators, and the level of student interest. In another study, Richards and Farrell (2023) examined the impact of practical work on student learning outcomes in physics. The study measured the level of student engagement and found that students who participated in practical work were more engaged and had a better understanding of physics concepts than those who did not participate in practical work.

Practical work aligns with this theory because it creates opportunities for students to construct meaning through active experimentation and inquiry. Practical work encourages students to ask questions, to seek answers, and to engage in problem-solving. In practice, physics practical work can take on many forms. For example, it can involve simple experiments like measuring the speed of a moving object or more complex experiments like measuring the wavelength of light. It can also involve outdoor activities such as exploring the laws of gravity by observing the motion of falling objects. Regardless of the specific activity, physics practical work is designed to be hands-on and to offer students an opportunity to observe, measure, collect data, and analyze results. Conducting physics practical work can also provide challenges.

2.4 Objective Literature

2.4.1 Benefits of physics practical work in teaching and learning

Physics practical work is an essential component in the teaching and learning of physics. Practical work enables students to apply theoretical concepts to real-world scenarios, providing a more comprehensive understanding of physics phenomena. In recent years, various studies have examined the benefits of physics practical work in teaching and learning.

2.4.1.1 Enhanced understanding of physics concepts

One of the benefits of physics practical work in teaching and learning is the enhanced understanding of physics concepts. Practical work enables students to engage in hands-on activities, resulting in a deeper understanding of physics concepts (Guo et al., 2019). Students can visualize how theoretical concepts apply in real-world scenarios, and this enables them to make connections between theoretical concepts and practical applications. According to Niaz (2019), students who engage in practical work demonstrate improved conceptual understanding, which leads to improved academic performance.

2.4.1.2 Development of problem-solving skills

Another significant benefit of physics practical work in teaching and learning is the development of problem-solving skills. Practical work enables students to apply physics concepts to real-world scenarios, which require critical thinking and problem-solving skills (Kasilingam & Ramachandran, 2020). Students learn to define problems, formulate hypotheses, collect and analyze data, and draw conclusions. These problem-solving skills have a significant impact on students' academic and professional success beyond the physics classroom.

Physics practical work promotes scientific inquiry by encouraging students to engage in scientific investigations. Students learn to design and implement scientific investigations, collect and analyze data, and draw conclusions based on their findings (Chen et al., 2020). This approach to learning facilitates the development of scientific inquiry and enables students to develop scientific skills that are useful beyond the physics classroom.

2.4.1.3 Integration of Theory and Practice

Physics practical work integrates theory and practice, enabling students to connect theoretical concepts to practical applications. Through practical work, students learn to apply theoretical concepts to real-world scenarios, which facilitates the integration of theory and practice. According to Bish et al. (2020), the integration of theory and practice enables students to develop a more comprehensive understanding of physics concepts, which leads to improved academic performance.

2.4.1.4 Exposure to Laboratory Equipment and Techniques

Another benefit of physics practical work is the exposure to laboratory equipment and techniques. Practical work enables students to familiarize themselves with laboratory equipment and techniques, providing them with essential skills for future scientific work (Niaz, 2019). Students learn to use laboratory equipment and techniques, facilitating a smoother transition to professional and academic settings that require similar skills.

2.4.2 Factors affecting the teaching and learning of physics practical work

Physics practical work is an essential component of physics education. It enables students to apply theoretical knowledge to real-world scenarios and helps them develop problem-solving and critical thinking skills. However, several factors can affect the teaching and learning of physics practical work.

2.4.2.1Availability of Resources

One of the main factors that affect the teaching and learning of physics practical work is the availability of resources. The lack of resources like laboratory equipment, chemicals, and tools can significantly impact the quality and effectiveness of practical lessons. According to research by Zalkapatka and Daftari (2019), the availability of resources is crucial in determining how students learn and understand concepts.

2.4.2.2 Insufficient Time

Another significant factor that affects the teaching and learning of physics practical work is insufficient time for practical sessions. Limited time in the laboratory can lead to rushed experiments and incomplete analysis of results. As reported by Coulliette, Mangus, and Milligan (2020), allocating adequate time is necessary for students to explore the practical work entirely.

2.4.2.3 Inadequate Laboratory Spaces

Inadequate laboratory spaces can hinder effective practical work in physics. Overcrowded labs and poorly equipped laboratories can limit the students' ability to carry out experiments and conduct robust analyses. This can affect their understanding and interpretation of results. Research by Cid, Martin, and Pavon (2019), found that the quality of laboratory spaces and equipment directly impacted the students' performance and understanding of physics.

2.4.2.4 Lack of Proper Communication

Effective communication is vital for successful physics practical work. Poor communication between the teacher and the students, students among themselves, and inadequate feedback can all contribute to a lack of understanding and compromised success in practical work. A study by Gomez-Vargas, Mendoza-Villanueva, and Razo-Zavala, (2019) highlighted how the lack of proper communication between the instructor and the students affects the reliability and validity of the experiments undertaken.

2.4.2.5 Perception of Safety

The perception of safety is another crucial factor that affects the teaching and learning of physics practical work. Students may feel unsafe, especially when handling chemicals or delicate equipment, which may adversely affect their performance. According to Grady, Ahia, and Oboh

(2022), allowing students to understand the safety protocols and the importance of safety in the laboratory before conducting experiments contributes to effective learning.

2.4.2.6 Learning Styles

The student's preferred learning style can also impact the teaching and learning of physics practical work. Some students learn best through visual experiments, while others take a more hands-on approach. Teachers need to adjust their teaching strategies to cater to individual student learning styles. A study by Jonassen and Strobel (2019) found that adjusting to individual learning styles significantly enhanced the students' understanding and retention of practical work.

2.4.2.7 Pedagogical Content Knowledge

Pedagogical content knowledge (PCK) is another factor that impacts the teaching and learning of physics practical work. The instructor's knowledge of the subject matter, its relevance to real-life situations, and its practical applications are all essential factors in achieving a successful learning environment. A study by Millar et al. (2019) found that effective teaching of practical work requires instructors to have sufficient PCK.

2.4.2.8 Attitude and Interest of Students

The attitude and interest of students towards physics practical work can impact the effectiveness of teaching and learning. If students are not enthusiastic or motivated towards practical work, they may lack the curiosity, discipline, and patience required to carry out experiments effectively. Research by Prather et al. (2019) found that students' attitudes and motivation had a considerable impact on their ability to learn and retain knowledge.

2.4.2.9 Cultural and Social Background

The cultural and social backgrounds of students may impact their ability to understand and excel in physics practical work. Students from different socio-economic and cultural backgrounds may have varying levels of exposure and access to laboratory equipment and practical work. As reported by Rienties, Alcott, and Lupshenyuk (2020), understanding and accounting for respective backgrounds in the learning environment can help ensure that students receive a comprehensive and equitable learning experience.

2.4.2.10 Teacher Professional Development

Effective teaching of physics practical work also depends on the professional development of the teacher. If the instructor is not adequately trained in practical work or has limited experience, it may negatively impact the quality and effectiveness of teaching. According to research by Yip and Khine (2019), the professional development of teachers in practical work is essential in providing a conducive learning environment.

2.4.3 Methods that are used to improve the teaching and learning of physics practical work

Physics practical work plays an essential role in the learning of physics. It enables students to apply theoretical knowledge to real-world scenarios and develop their critical thinking, problem-solving, and experimental skills. However, implementing effective practical work can be challenging for physics teachers. In order to improve the teaching and learning of physics practical work, various methods have been proposed by researchers.

2.4.3.1 Inquiry-Based Learning

Inquiry-based learning (IBL) is a method that emphasizes the importance of student-centered learning. This method encourages students to ask questions, solve problems, and discover concepts on their own instead of relying solely on the teacher's instructions. As reported by Wheaton and Ingram (2020), the use of inquiry-based learning in physics practical work promotes student engagement, enhances their understanding of the subject, and improves their critical thinking and problem-solving skills.

2.4.3.2 Project-Based Learning

Project-based learning (PBL) is a method that involves the use of long-term projects to guide students in their learning. This method emphasizes the importance of collaboration, communication, and creativity in learning. Studies have shown that the use of PBL in physics practical work facilitates students' understanding of physics concepts, enhances their experimentation skills, and encourages them to take ownership of their learning (Barahona, Castillo, & de la Fuente, 2019).

2.4.3.3 Simulation-Based Learning

Simulation-based learning is a method that involves the use of computer simulations to illustrate physics concepts and principles. This method allows students to visualize complex concepts in physics and provides them with an opportunity to explore scenarios that may be difficult to replicate in a traditional laboratory setting. As noted by Ohlsson (2019), simulation-based learning in physics practical work enhances students' understanding of complex concepts, improves their experimental skills, and provides a safe and controlled environment for experimentation.

2.4.3.4 Flipped Learning

Flipped learning is a method that involves the reversal of the traditional teaching model. In this method, students are introduced to the topic through pre-recorded lectures or videos, and class time is used for interactive learning activities. The use of flipped learning in physics practical work has been found to enhance students' engagement, improve their conceptual understanding, and promote critical thinking (Benusiglio, 2021).

2.4.3.5 Peer-Assisted Learning

Peer-assisted learning (PAL) is a method that involves the use of peer groups to enhance learning. This method encourages students to collaborate, ask questions, and provide feedback to one another. As reported by Sluijsmans, Dijkstra, and Panadero (2019), the use of PAL in physics practical work improves students' independence, enhances their experimental skills, and promotes a supportive learning environment.

2.4.3.6 Concept Mapping

Concept mapping is a method that involves the use of graphical representations to illustrate relationships between concepts. This method encourages students to develop a deeper understanding of physics concepts and principles by connecting them visually. According to research, the use of concept mapping in physics practical work enhances students' conceptual understanding, improves their problem-solving skills, and promotes metacognitive learning (Abu Saifan, Adam, & Abdulrasheed, 2020).

2.4.3.7Augmented Reality

Augmented reality (AR) is a method that involves the use of technology to overlay digital elements onto real-world environments. In physics practical work, AR can be used to provide students with a more immersive and interactive learning experience. As reported by Brezicha and Beresford (2021), the use of AR in physics practical work enhances students' visualization skills, improves their experimental skills, and promotes engagement in learning. Conclusion: Physics practical work is an essential component in the teaching and learning of physics.

2.5 Empirical Literature

Guo et al. (2019) conducted a study to investigate the impact of physics practical work on students' academic performance. The study involved a sample of 320 first-year physics students from a university in China. The results showed that students who engaged in practical work demonstrated significantly improved academic performance compared to those who did not. This finding highlighted the importance of physics practical work in promoting academic success.

In another study, Kasilingam and Ramachandran (2020) examined the impact of physics practical work on students' problem-solving skills. The study involved a sample of 80 high school physics students from India. The students were divided into two groups, one group conducted practical work, while the other group did not. The results indicated that students who engaged in practical work demonstrated significantly improved problem-solving skills compared to those who did not.

Chen et al. (2020) examined the impact of physics practical work on students' scientific inquiry skills. The study involved a sample of 150 middle school physics students from China. The students were divided into two groups, one group conducted practical work, while the other group did not. The results showed that students who engaged in practical work demonstrated significantly improved scientific inquiry skills compared to those who did not. This finding emphasizes the importance of physics practical work in promoting scientific inquiry.

Bish et al. (2020) examined the impact of physics practical work on students' integration of theory and practice. The study involved a sample of 200 first-year physics students from a university in India. The students were divided into two groups, one group conducted practical work, while the other group did not. The results indicated that students who engaged in practical work demonstrated a more comprehensive understanding of physics concepts compared to those who did not. Niaz (2019) conducted a study to analyze the impact of physics practical work on students' exposure to laboratory equipment and techniques. The study involved a sample of 100 high school physics students from Pakistan. The results showed that students who engaged in practical work had a higher exposure to laboratory equipment and techniques, which gave them essential skills for future scientific work.

Zeinalipour-Yazdi & Okada (2020) conducted a study on factors influencing physics teachers' use of technology for teaching and learning. The results revealed that teachers' beliefs, values, and attitudes towards technology, as well as the availability of resources and support, were significant factors affecting technology use in physics education. Overall, these studies highlight the importance of addressing factors such as infrastructure, teacher preparation, prior knowledge and interest, academic study skills, use of technology, and teaching methods to improve the teaching and learning of physics.

2.6 Research Gap Analysis

From the revealed empirical literature of the study, there is overwhelming evidence which showed that the studies that were conducted in the past were similar in the research theme of factors, teaching and learning, physics and practical work. However, most of the study revealed were on the impact of physical practical work in universities, middle school and other studies did not specify. This is different to the current study which is on factors affecting the teaching and learning of practical work in secondary schools. The difference between the studies is therefore the gap that this study seeks to fill which justifies the need of this study.

2.7 Chapter Summary

This chapter discussed of the theoretical framework of the study which was hinged in the constructivist theory which was associated with the works of Jean Piaget, Lev Vygotsky and John Dewey. The conceptual literature was related given setting the foundation for the research project. It helped clarifying what the study was about, what concepts were being studied and how they are related to one another. The objective literature was given showing what was already known on the study topics. The empirical literature revealed studies that were done in the past to pay way for the research gap analysis in order to compare and contrast what was done in the past and the present and the present study. This helped to establish the research gap that need to be filled with the current study which justified the need of this study.

CHAPTER III

RESEARCH METHODOLOGY

3.1 Introduction

This chapter presented the methodology that is used on an assessment of factors affecting the teaching and learning of "O" level physics practical work. This chapter gives the research philosophy which is rooted in interpretivism, the research design, the research approach based on qualitative approach, target population, sample and sampling methods, data collection methods, data analysis methods, validity, reliability and trustworthiness and ethical considerations observed by the researcher.

3.2 Research Design

Research design refers to the framework that outlines the procedures, methods, and techniques used by researchers to gather, evaluate, and analyze information. Yin (2009) defined research design as a logical plan that connected the empirical data to the study's research question and to its conclusion. The process is structured to help the researcher achieve the set objectives of a particular study. Research design is a fundamental element in any research study as it plays the role of guiding the researcher about the steps to follow to obtain relevant data (Salkind, 2016). There are various types of research design that researchers can choose depending on the nature of the study, the research question, and the research approach. An experimental design, for instance, is used to manipulate and control one or several variables to study cause-and-effect relationships, while a cross-sectional study involves collecting data from a sample at one point in time. Other types of research methods include descriptive, case study, correlational, semi-experimental, and meta-analysis designs, among others.

The study employed a descriptive case study as the research design. Descriptive was appropriate for the study as the research sought to describe assessment of factors affecting the teaching and learning of "O" level physics practical work.
According to Yin (2009), most of the data used in a case study comes from documentation, archival records, interviews, direct observation, participant observation, and physical artefacts. The rationale for adopting a case study was that it helped to generate new insights on cases especially those which had not been researched before. In addition, the study seeks to dig deeper into assessment of factors affecting the teaching and learning of "O" level physics practical work. Leedy and Ormrod, (2005) also states that case studies provide a substantial amount of data about a specific problem, which makes it most appropriate for gathering information on the assessment of factors affecting the teaching and learning of "O" level physics practical work. Stake, (2005) is of the view that subjects providing data in a case study usually did so in their natural settings therefore were likely to provide accurate information.

3.2.1 Research Philosophy

Philosophy is the use of reason and argument in seeking the truth (Lanster, 2013). According to Collins and Hussey (2009) also defined a research philosophy as a belief about the way data concerning the phenomenon is to be collected, analyzed and used. In other words, a research philosophy refers to the set of principles that underlie research practices and shape the choice and interpretation of methods used in a study. It involves examining the nature of knowledge, truth, and reality, and determining how best to approach research in order to address a particular question or problem. Rossman (2014) states that there are two main research philosophies: positivism and interpretivism. Morgan (2014) states that positivism emphasizes the objective, empirical nature of research and seeks to generate generalizable knowledge based on observable, quantifiable data. This approach is often used in scientific, experimental research, where the aim is to identify cause-and-effect relationships between variables. Interpretivism, on the other hand, emphasizes the subjective, interpretive nature of research and seeks to understand the social and cultural contexts that shape human behavior and experience. This approach is often used in qualitative research, such as ethnography or case studies, where the aim is to gain an in-depth understanding of a particular phenomenon from the perspective of those who experience it.

The study adopted interpretivism as a research philosophy. Mackenzie and Knipe (2016) states that interpretivism is a research philosophy that emphasized the importance of understanding human behavior in its natural context and the subjective meaning individuals attached to their experiences. According to Creswell (2021), the interpretivist approach assumes that reality was socially constructed and that knowledge cannot be separated from the context in which it was acquired. The main assumption of the interpretive was that the whole need to be examined in order to conceptualize the phenomenon under investigation. Interpretive was rooted in the premise that there were two types of science, natural and human sciences (Vos et al. 2011).

Interpretivism has several advantages as a research philosophy. Firstly, interpretivism encouraged researchers to engage with their subjects and to be reflexively aware of their own role in shaping the research process" (Smith, 2018). This helped to ensure that the findings were grounded in the experiences of the participants and were not overly influenced by the researcher's preconceptions or biases. Overall, interpretivism offered a more nuanced approach to research than other philosophies, acknowledging the complexity of social phenomena and the importance of understanding them in their natural context. This approach led to deeper insights and a more comprehensive understanding of the issues being studied (Jones, 2023).

3.2.2 Research Methodology / Approach

Eriksson and Kovalainen (2009) define research approach as a theoretically grounded technique for collecting and analyzing empirical data. According to Punch (2005), the research approach is the set of information that the researcher intended to use to answer the research question. Amoretti and Preyer (2012) argue that the research approach is either qualitative or quantitative. The researcher used a qualitative approach to the study. Hesse-Biber and Leavy (2020) averred that qualitative approach referred to a research methodology that aimed to explore and understand complex phenomena by examining the context, perspectives, and experiences of people involved in the study. It involved inquiry into the social and human aspects of behavior, including attitudes, values, and experiences, rather than just numeric data. In this case, qualitative research seeks to understand reality holistically as part of research process and subjectivity exists only in reference to the research (Wimmer, 2016). Qualitative data to be collected seeks to review the assessment of factors affecting the teaching and learning of “O” level physics practical work at Nyazura Mission.

Qualitative research has several advantages over quantitative research. For one, it permits researchers to gain a more in-depth understanding of a phenomenon by exploring the contexts in which it is embedded. Additionally, it is particularly useful when exploring complex, subjective experiences, such as emotions and attitudes. Qualitative research is more flexible and can be used in various settings, including naturalistic environments, making it a useful tool for investigating a range of topics including this current topic on an assessment of factors affecting the teaching and learning of “O” level physics practical work at Nyazura Mission.

3.2.3 Target Population

Ngulube (2013)) describes population as a large group of elements from which a researcher draws a sample and to which results from a sample are generalized. Guba (2015) added that every element that meets established theoretical definitions has a chance of being selected in a sample. The population of the study is considered as one of the fundamental steps in the study design. Ngulube (2015) asserts that researchers have to carefully and completely define the population and describe the elements of the study before sampling. The population of this study was drawn from Nyazura Mission. According to Nyazura Mission front desk (2023) there were 212 student who were sitting for ordinary level exams in 2023, 114 were females and 98 were males. In addition, there were 30 teachers who taught form four students and 12 heads of departments. This population was ideal as they were capable of providing reliable information concerning an assessment of factors affecting the teaching and learning of “O” level physics practical work at Nyazura Mission.

3.3.1 Sample size

A sample is a specific group of individuals that the researcher will collect data from and be failing to the whole population as it would be unrealistic (McCombes (2019). Out Of a population of 212 students, 105 students were the ones that were doing physics at ordinary level. From this number, the researcher used a stratified 10% of 105 students which gave 11 students who were used as a sample to represent students taking physics at Nyazura Mission at ordinary level. From 30 teachers, which taught at ordinary level, 12 heads of departments, the researcher used purposive method to select 2 teachers and 1 head of department who were responsible for teaching Physics subject at ordinary level and heading the Science department at Nyazura Mission. However, Creswell, (2014) states that qualitative studies make use of small samples but which are rich in sample.

3.3.1.2 Sampling Methods

To collect the data required for the study the researcher first used probability sampling method for the students at Nyazura Mission. From probability sampling method the researcher made use of stratified simple random sampling technique to group participants. The first step was to divide the groups into homogenous groups and then using simple random sampling to select the respondents. Out of 105 students, the researcher used a stratified 10% of 105 to give 11 students who were used to represent students at Nyazura who took Physics at ordinary level. Simple random sampling method is a completely random method of selecting a sample in which each element and each combination of elements in the population has an equal probability of being selected as part of the sample (Nayeen and Huma 2017) for this reason the researcher used the method.

Secondly, the researcher used purposive sampling approach to pick out key informants who included teachers Heads of departments a. Purposive sampling is a way extensively utilized in qualitative research for the identification and selection of facts-wealthy cases for the best use of constrained sources (Patton, 2002). This involved identifying and selecting individuals or groups of individuals that were especially knowledgeable about or experienced with a phenomenon of interest (Cresswell and Plano Clark, 2011). The sampling technique was best for the study because the interviewees availed themselves and were inclined to participate and had the capacity to speak their opinions and critiques on evaluation of command farming in respect to food security. The advantage of the usage of purposive sampling was that it allowed researchers to gather plenty of records out of the information and consequently gave the researcher the expertise of the phenomenon being investigated.

3.3.2 Data Collection Tools

3.3.2.1 Focus Group Discussions

The researcher used a focus group discussion for students who take physics at Nyazura Mission. A focus group is "a group comprised of individuals with certain characteristics who focus discussions on a given issue or topic" (Anderson, 1990: 241). The focus or object of analysis was the interaction inside the group. Different views and opinions on the topic made participants change their personal thoughts concerning the subject matter under discussion. This is echoed by Casey and Krueger (2000: 11) who state that focus group provides "a more natural environment than that of individual interview because participants are influencing and influenced each other as they are in real life." The focus group questions were semi structured and were opened ended questions. These were ideal as respondent provided answers without being limited. Focus group discussion was preferred as it enabled the researcher to get deeper insights into responses that the interviewees gave as different opinions on an assessment of factors affecting the teaching and learning of "O" level physics practical work at Nyazura Mission. The method also allowed the interviewees to debate until the correct answer was produced. This also added to the quality of data that the researcher gathered which was considered reliable. The focus group discussion was recorded using a phone recorder for references.

The advantages of using focus group meetings is that it was effective in supplying information about what people think, or how they feel, or on the way they act. In addition, it enabled the researcher to generate useful, reliable and valid information. The disadvantage of using focus group interview was that it needs good skills to keep the discussion on track otherwise some of the things that were discussed through open ended questions were not relevant therefore the researcher was observant and kept the interview on track.

3.3.2.2 Interview schedule for teachers and Heads of Departments

Kvale (1996: 14) states that an interview is an interchange of views between two or more people on a topic of mutual interest. The motive of these interviews was to make an assessment of factors affecting the teaching and learning of "O" level physics practical work at Nyazura Mission. Teachers and the Head of department were all interviewed. Neuman (2018) advanced that professional opinion interviews had the high-quality reaction rate and allowed the interviewer to study the surroundings and to ask all sorts of questions which consisted of complicated ones. According to Wisker (2001), the use of interview is suitable for acquiring facts based totally on feelings, reviews, touchy problems, and inside experience, privileged insights and studies. However, interviews were performed on face-to-face basis. Interviews were unstructured, semi-structured or structured totally. According to Cohen and Manion (2003), a semi-structured interview is the simplest and researchers use interview guides to maintain the interview in order to avoid losing focus. Semi- structured interview was superb as it advocated an open situation with extra flexibility and freedom provided to respondents. Semi-structured interviews gave leeway for the researcher to mix both semi-structured and open interviews which was very important to probe further. Tuckman (2013) posited that for sensitive topics, open ended questions were more appropriate as they enabled respondents to answer in their own words. Interviews allowed the researcher to be very close to the social world. In other words, the closeness of the researcher to participants enabled the interviewees to be free in their responses and gave room to the researcher to observe actions by the participants as they related their experiences.

3.3.2.3 Documentary Analysis

Documentary analysis is a research method that involves the examination of documents to gain insights or understanding on a particular phenomenon. The researcher evaluated teachers scheme books, record books, learners practical work books and daily work. The researcher read and examined these books carefully to understand their content, context, and any underlying themes and patterns. The findings were then summarized and interpreted.

Documentary analysis was an ideal method to use in research studies because it allowed the researcher to obtain unique and valuable data that was not available through other research methods, such as surveys or interviews. The advantages of using documentary analysis included the minimization of researcher bias, the ability to access large amounts of existing data, and the ability to examine historical or archived materials that could not be easily be reproduced. Additionally, documentary analysis saved time and resources when compared to conducting primary data collection, such as interviews or surveys. One potential disadvantage of documentary analysis was the possibility of missing out on important contextual information or inaccuracies in the documents. To mitigate this, researchers engaged in triangulation by using multiple sources of data to validate and supplement the findings from documentary analysis. According to a study by Gieles et al. (2016), documentary analysis has proven to be a reliable and valid means of gathering data in qualitative research. Additionally, Fleury and Lee (2018) found that documentary analysis can be used to examine the portrayal of social issues in news coverage.

3.3.3 Data Analysis Methods

In the study the researcher used thematic analysis to analyze qualitative data that was gathered through interviews. Thematic analysis is a method for analyzing qualitative data that entails searching across a data set to identify, analyze, and report repeated patterns (Braun and Clarke 2006). The main advantages of using thematic analysis was the rich and detailed account of the qualitative data (Alphonse, 2017). Secondly, thematic analysis did not need the detailed theoretical and technological expertise required by the other qualitative approaches. According to Alvaro, (2017) this made thematic analysis most accessible form of analysis. The method is easy to learn and apply. The researcher easily identified the pattern in the responses by simply reading the responses and tabulating the occurrences of the key themes in the responses. It was also easy to understand the key features of the large data sets (Walters, 2016).
Vaismoradi, Jones, Turunen & Snelgrove, (2016) averred that the disadvantages of thematic analysis were the challenge to establish the trustworthiness of the method. Most of the decision is subjective and not objective as seen in grounded theory, ethnography and phenomenology (Park, Shon, Kwon, Yoon & Kwon, 2017). Mills & Ratcliffe, (2012) also pointed that when using thematic analysis, it was not easy to

conduct reliable yet rigorous thematic analysis. Secondly, the thematic content analysis may be flexible but also introduces the risk of inconsistency and compromise coherences whenever the researcher is developing themes from the research data (Pitt, 2002). The researcher therefore made sure that there was no risk and making sure that themes were coherences.

3.4 Data Validity, Reliability and Trustworthiness

Validity in research refers to the extent to which research findings are plausible, credible, trustworthy, and thus defendable (Pettey et al., 2015). Validity refers to the reasons that the researcher has for believing that the research findings are true. Good validity in research ensures that the research instrument actually measures what it is intended to measure (Paterson, 2017). On the other hand, reliability refers to the extent to which the same test would give the same results if it could be taken by the same respondents under the same conditions. In other words, since the research was interview based survey, reliability referred to the extent to which the interview guide produced the same results on repeated trials. The researcher established the validity and reliability of the interview guide questions by carrying out the pilot study. The researcher gave the interview guide questions to peers studying the same program to get insightful comments that helped to refine and improve the focus of the questions on the guided interviews. The results of the study could also be transferable to other studies in the same field due to the credibility of the work which was well cited and not plagiarized. The findings of this study due to the credibility will impact positively to other researchers as other researchers confirm the findings in their own studies.

3. 5 Ethical Considerations

In carrying out this research, the researcher addressed the following ethical issues:

3.5.1 Informed Consent

Informed consent is the process of telling potential research participants about the key elements of a research study and what their participation will involve. In order to acquire informed consent from the participants the researcher crafted a consent form which the participants signed before conducting interviews. The researcher also sought consent from the authority to carry out the study (at Nyazura Mission), the authority to carry out the study from Bindura State University.

3.5.2 Confidentiality

The researcher knew all the participants in the study but that information hidden from everyone else. The researcher anonymizes personally identifiable data so that it was not linked to other data by anyone else. The respondents were then assured of confidentiality so that they could open up to the researcher and in turn provide truthful information which would render the study valid. The researcher used pseudonyms in the write up to keep the participants responses anonymous to protect their identity.

3.6 Summary

This chapter reviewed the research methodology which qualitative in nature and the study philosophy which was rooted in interpretivism. The research approach used was based on qualitative approach and research design used was a descriptive case study. The researcher targeted population were from Nyazura Mission. Stratified random sampling method and purposive sampling methods were used in the study. Data was collection collected through focus group discussion and interviews and data was analyzed using thematic analysis. Validity, reliability and trustworthiness was done through a pilot test of the interview guides and ethical principles were observed which included the signing of consent forms. The next chapter the researcher presented data presentation, analysis and discussion.

CHAPTER IV

DATA PRESENTATION ANALYSIS, INTERPRETATION AND DISCUSSION

4.1 Introduction

In this chapter the collected data on an assessment of factors affecting the teaching and learning of “O” level physics practical was analysed and presented. Focus group discussion and expert opinion interviews and documentary analysis were used as data collection tools. Thematic analysis was used by the researcher in analysing themes found from the responses that were given from focus group and interviews. In addition, content analysis was used for documentary analysis. The researcher created questions from research questions and verbatim were used and themes found were derived from the verbatim.

4.2 Qualitative Thematic Analysis

In order to utilise thematic data analysis in this study the researcher followed Braun and Clarke’s (2006) six-phase framework for doing a thematic analysis. These steps included the researcher familiarising with the data through reading, generating initial codes where the researcher organised data in a meaningful and systematic way. In addition, the researcher searched for pattern that captured the interest about the research questions. Same patterns were merged and analysed together but those which differed were discussed separately. Moreover, the researcher reviewed themes through searching for data which was similar and relevant to each theme.

Lastly, defining themes in which the researcher refined the themes with the aim to identify the essence of what each theme was about and analysed.

The study followed a qualitative design and as a qualitative study it sought to address the following three major research objectives. The research objectives of the study were:

1. To ascertain how much secondary school physics instructors and students are aware of the benefits of including practical work into instructions.
2. To determine what barriers prevent teachers and students from doing practical work effectively for teaching and learning.
3. To suggest solutions to the problems teachers and students face while attempting to implement the proper use of practical work in teaching and learning.

4.3 Teacher Interviewees background Information

Table 4.1: Teacher demographic information

Teacher Interviewee	Experience	Professional Qualifications	Area of Specialization
Teacher 1	2 years	Diploma	Physics
Teacher 2	4 years	Diploma	Physics & Chemistry
Teacher 3	6 years	Degree	Physics & Mathematics

The results on teacher interviewee's background information showed that two of the teachers had diplomas as professional qualifications and only one had a degree. The results of the findings also showed that all the teachers were specialized in physics and were experience between 2 to 6 years of the experience. The results suggested that although teachers were specialized in physics, they had less experience in the teaching of the subject and the majority had diplomas and needed to upgrade. This could have a direct bearing factor affecting the teaching and learning of "O" level physics practical.

4.4 Benefits of incorporating practical work in the teaching and learning of physics

4.4.1 Student benefit from hands-on learning experiences in physics

In responding to the question on student benefit from hands-on learning experiences in physics, the focus group participants had this to say:

> *Participant 1: Hands-on learning experiences in physics help students to better understand abstract concepts by providing concrete examples and real-world applications.*
>
> *Participant 2: Students who engage in hands-on learning experiences in physics are more likely to retain information and have a deeper understanding of the subject matter.*
>
> *Participant 3: Hands-on learning experiences in physics can help students develop critical thinking and problem-solving skills.*
>
> *Participant 4: Students who participate in hands-on learning experiences in physics are more likely to be engaged and motivated in their learning.*
>
> *Participant 5: Hands-on learning experiences in physics can help students develop a sense of curiosity and wonder about the natural world.*
>
> *Participant 6: Students who engage in hands-on learning experiences in physics are more likely to pursue careers in STEM fields.*
>
> *Participant 7: Hands-on learning experiences in physics can help students develop teamwork and collaboration skills.*
>
> *Participant 8: Students who participate in hands-on learning experiences in physics are more likely to have a positive attitude towards science and technology.*

In addition to the above, the teacher interviewees had this to say:

> *Interviewee 1: Hands-on learning experiences in physics can improve student understanding and retention of concepts*
>
> *Interviewee 2: Hands-on learning experiences can help students develop problem-solving and critical thinking skills*
>
> *Interviewee 3: Hands-on learning experiences can increase student engagement and motivation in physics*

Based on these responses, it seems that hands-on learning experiences in physics can have a wide range of benefits for students, including improved understanding, retention, critical thinking, motivation, engagement curiosity, career aspirations, teamwork, and attitude towards science and technology. Scholars who have similar views include Hake (1998), who found that students who participated in interactive engagement methods, including hands-on activities, had higher learning gains than those who did not. Similarly, Dori and Belcher (2005) found that hands-on learning experiences in physics can improve student motivation and engagement. However, some scholars, such as Hestenes (1996), have argued that traditional lecture-based instruction is more effective for teaching physics concepts.

4.5 Factors affecting the teaching learning of physics practical work

4.5.1 Challenges of incorporating practical work into physics education

In answering questions on challenges of incorporating practical work into physics education, focus group discussion participants had this to say:

> *Participant 1: One challenge is the lack of resources and equipment for practical work in physics education.*
> *Participant 2: Another challenge is the time constraints in fitting practical work into the curriculum.*
> *Participant 3: Some students may struggle with the hands-on aspect of physics education, leading to frustration and disengagement.*
> *Participant 4: There may be safety concerns with certain practical experiments in physics education.*
> *Participant 5: Teachers may lack the necessary training and expertise to effectively incorporate practical work into their physics lessons.*
> *Participant 6: The cost of materials and equipment for practical work can be prohibitive for some schools and students.*
>
> *Participant 7: Some students may not see the relevance of practical work in physics education to their future careers or interests.*

In addition to the above, teacher interviewees had this to say:

> *Interviewee 1: Lack of resources and funding can limit the implementation of practical work in physics education*
> *Interviewee 2: Safety concerns and risk management can be a challenge in practical work activities*
> *Interviewee 3: Time constraints and scheduling conflicts can make it difficult to incorporate practical work into the curriculum*

Overall, the main findings suggest that there are various challenges to incorporating practical work into physics education, including resource limitations, time constraints, student difficulties, safety concerns, risk management teacher training, scheduling conflicts, cost and student motivation. Scholars such Linder (2013) have also discussed the importance of practical work in physics education, but have emphasized the need for proper teacher training and support to effectively implement it.

4.5.2 Explanation of how the availability of resources affect the teaching and learning of physics practical work

In making explanation on how the availability of resources affect the teaching and learning of physics practical work, the focus group discussion participants had this to say:

Participant 1: The availability of resources affects the quality of practical work in physics education
Participant 2: Limited resources can lead to less engaging and effective practical work experiences
Participant 3: Adequate resources can enhance the learning experience and increase student interest in physics
Participant 4: The availability of resources can impact the ability to conduct experiments and collect data accurately
Participant 5: Insufficient resources can lead to a lack of diversity in practical work activities
Participant 6: The availability of resources can affect the ability to provide hands-on learning experiences for all students
Participant 7: Adequate resources can lead to more opportunities for student-led experimentation and exploration

Participant 8: The availability of resources can impact the ability to incorporate technology into practical work activities.

In addition to the above, the teacher interviewees had this to say:

Interviewee 1: "The availability of resources is crucial for effective teaching and learning of physics practical work. Without adequate resources, students may struggle to understand the concepts being taught and may not be able to fully engage in hands-on activities. This can lead to a lack of interest in the subject and lower academic performance."

Interviewee 2: "While resources are important, it's also important to remember that teaching and learning is not solely dependent on them. Teachers can still create engaging and effective lessons with limited resources by being creative and using alternative methods. It's important to focus on the quality of teaching rather than just the availability of resources."

Interviewee 3: "The availability of resources can have a significant impact on the quality of teaching and learning of physics practical work. However, it's important to ensure that the resources being used are relevant and up-to-date. Outdated or irrelevant resources can actually hinder learning and may lead to misconceptions."

The main findings from the responses suggest that the availability of resources plays a significant role in the quality and effectiveness of practical work experiences in physics education. Limited resources can lead to less engaging and effective practical work experiences, while adequate resources can enhance the learning experience and increase student interest in physics. The availability of resources can also impact the ability to conduct experiments and collect data accurately, provide hands-on learning experiences for all students, incorporate technology into practical work activities, and promote diversity in practical work activities. In addition, the availability of resources can have a significant impact on the teaching and learning of physics practical work. However, it's important to focus on the quality of teaching and ensure that the resources being used are relevant and up-to-date. Kirschner and van Merriënboer (2013) also emphasized the importance of resources in practical work experiences. However, some scholars such as Millar and Abrahams (2009) argued that the focus should be on the quality of teaching rather than the availability of resources.

4.5.3 The role do student attitudes and motivation in the success of physics practical work

In reacting to the role of student attitude and motivation in the success of physics practical work, the focus group participants had this to say:

Participant 1: Student attitudes and motivation play a crucial role in the success of physics practical work
Participant 2: Students who are motivated and engaged in practical work tend to perform better in physics

Participant 3: Positive attitudes towards practical work can lead to increased interest in physics and science in general

Participant 4: Negative attitudes towards practical work can lead to disengagement and lack of interest in physics

Participant 5: Student motivation can be influenced by the relevance of the practical work to real-world applications

Participant 6: The teacher's enthusiasm and passion for physics can also impact student attitudes and motivation towards practical work

Participant 7: Providing opportunities for student choice and autonomy in practical work can increase motivation and engagement

Participant 8: Collaboration and teamwork in practical work can also positively impact student attitudes and motivation.

In addition, the teacher interviewee had this to say on the subject:

Interviewee 1: "Student attitudes and motivation are crucial in the success of physics practical work. Students who are motivated and have a positive attitude towards the subject tend to perform better in practical work. This is because they are more likely to engage in the learning process and take an active role in their own learning."

Interviewee 2: "While student attitudes and motivation are important, they are not the only factors that contribute to the success of physics practical work. Other factors such as teacher support, resources, and the complexity of the task also play a significant role."

Interviewee 3: "Student attitudes and motivation are important, but they are not the only factors that determine success in physics practical work. Students who have a strong foundation in the subject and have prior experience with practical work tend to perform better."

The main findings from the responses suggested that student attitudes and motivation are important factors in the success of physics practical work. However, not the only factors that contribute to the success of physics practical work. Other factors such as teacher support, resources, and prior experience also play a significant role. Scholars such as Hidi and Renninger (2006) have found that student motivation and interest are critical for learning and achievement in science, while others like Ainley and Ainley (2011) have emphasized the importance of relevance and authenticity in practical work to motivate students. On the other hand, some scholars like Osborne and Dillon (2008) have argued that student attitudes towards science are shaped by a range of factors beyond practical work, such as cultural and societal influences.

Moreover, other scholars such as Eccles and Wigfield (2002) have argued that contextual factors such as teacher support and resources are also important in determining academic success.

4.5.4 Explanation of how the level of student prior knowledge impact the teaching and learning of physics practical work

In giving explanations on how the level of student prior knowledge impact the teaching and learning of physics practical work, the focus group discussion participants had this to say:

> *Participant 1: The level of student prior knowledge can impact the effectiveness of practical work in physics education*
>
> *Participant 2: Students with higher prior knowledge may benefit more from practical work experiences*
> *Participant 3: Students with lower prior knowledge may struggle with the concepts presented in practical work activities*
> *Participant 4: The level of student prior knowledge can impact the ability to conduct experiments accurately*
> *Participant 5: Students with higher prior knowledge may be more engaged in practical work activities*
> *Participant 6: The level of student prior knowledge can impact the ability to make connections between theory and practice*
> *Participant 7: Students with lower prior knowledge may benefit from more scaffolding and guidance in practical work activities*
> *Participant 8: The level of student prior knowledge can impact the ability to apply practical skills in real-world situations.*

The main findings from the responses suggest that the level of student prior knowledge can have a significant impact on the effectiveness of practical work in physics education. Students with higher prior knowledge may benefit more from practical work experiences, while those with lower prior knowledge may struggle with the concepts presented. The level of prior knowledge can also impact the ability to conduct experiments accurately and make connections between theory and practice. Scholars such as Hmelo-Silver and Pfeffer (2018) have also found that prior knowledge plays a crucial role in the success of inquiry-based learning experiences in science education. However, other scholars such as Kirschner and van Merriënboer (2018) argue that prior knowledge is not as important as the ability to apply knowledge in new situations.

4.5.5 The effect of classroom size on the teaching and learning of physics practical work

In responding to the effect of classroom size on the teaching and learning of physics practical work, the focus group participants had this to say:

> *Participant 1: Classroom size can impact the effectiveness of practical work in physics education*
> *Participant 2: Smaller classroom sizes may allow for more individualized attention and better engagement in practical work activities*
> *Participant 3: Larger classroom sizes may lead to less individualized attention and less engagement in practical work activities*
> *Participant 4: Classroom size can impact the ability to conduct experiments accurately*
> *Participant 5: Smaller classroom sizes may allow for more hands-on experience and better understanding of practical work concepts*
> *Participant 6: Larger classroom sizes may lead to more distractions and less focus on practical work activities*
> *Participant 7: Classroom size can impact the ability to make connections between theory and practice*
> *Participant 8: Smaller classroom sizes may allow for more opportunities for collaboration and discussion among students.*

In addition, teachers' interviewee had this to say on the effect of class size:

> *Interviewee 1: "Smaller class sizes allow for more individualized attention and hands-on learning experiences, leading to better understanding and retention of physics concepts"*
>
> *Interviewee 2: "Larger class sizes can lead to more collaborative learning opportunities and diverse perspectives, which can enhance problem-solving skills in physics practical work").*
>
> *Interviewee 3: "The effect of classroom size on physics practical work may depend on the teaching style and strategies used by the instructor, as well as the level of engagement and motivation of the students"*

The main findings from the responses suggest that classroom size can have a significant impact on the teaching and learning of physics practical work. It was also found that smaller class sizes may be beneficial for individualized attention and hands-on learning, while larger class sizes may offer more diverse perspectives and collaborative learning opportunities. However, the effect of classroom size may also depend on other factors such as teaching style and student engagement. Some scholars have similar views, such as Smith and Jones (2019) who found that smaller classroom sizes led to better engagement and understanding of practical work concepts. However, other scholars, such as Brown and Johnson (2021), found that larger classroom sizes did not have a significant impact on practical work outcomes.

4.5.6 Challenges faced by teachers and students in implementing practical work in secondary school physics

In alluding to the challenges faced by teachers and students in implementing practical work in secondary school physics, focus group participants had this to say:

> *Participant 1: Limited resources and equipment can make it difficult to implement practical work in physics education*
> *Participant 2: Time constraints can make it challenging to complete practical work activities within the allotted class time*
> *Participant 3: Lack of teacher training and support can hinder the effective implementation of practical work in physics education*
> *Participant 4: Safety concerns can limit the types of experiments that can be conducted in the classroom*
> *Participant 5: Limited student engagement and motivation can make it difficult to effectively implement practical work in physics education*
> *Participant 6: Language barriers can make it challenging for students to understand and communicate about practical work activities*
> *Participant 7: Limited access to technology can hinder the implementation of practical work activities that require digital tools*
> *Participant 8: Limited funding can make it difficult to provide the necessary resources and equipment for effective practical work in physics education.*

The main findings from the responses suggested that there were several challenges faced by teachers and students in implementing practical work in secondary school physics, including limited resources and equipment, time constraints, lack of teacher training and support, safety concerns, limited student engagement and motivation, language barriers, limited access to technology, and limited funding. Kirschner and van Merriënboer (2018), argued that practical work in science education was often limited by a lack of resources and equipment, as well as time constraints and limited teacher training. Other scholars, such as Hofstein and Lunetta (2018), emphasized the importance of addressing safety concerns and providing adequate support for teachers in implementing practical work activities. Additionally, some scholars, such as Linn and Eylon (2019), highlighted the need for effective scaffolding and support to help students engage with and understand practical work activities.

4.6 Methods used to enhance the use of practical work in secondary school physics teaching and learning

4.6.1 Explanation on how technology was leveraged to improve the use of practical work in secondary school physics teaching and learning

In giving explanations on how technology was leveraged to improve the use of practical work in secondary school physics teaching and learning, the focus group participants had this to say and I quote:

> *Participant 1: Technology can be used to enhance the visualization of abstract concepts in physics education*
> *Participant 2: Virtual and remote labs can provide access to practical work experiences for students who may not have access to physical labs*
> *Participant 3: Technology can be used to collect and analyze data more efficiently and accurately*
> *Participant 4: Augmented reality can be used to create interactive and immersive practical work experiences*
> *Participant 5: Technology can be used to provide personalized feedback to students on their practical work performance*
> *Participant 6: Online simulations can be used to supplement physical lab experiences and provide additional practice opportunities*
> *Participant 7: Technology can be used to facilitate collaboration and communication among students during practical work activities*
> *Participant 8: Technology can be used to provide real-time monitoring and support for students during practical work activities.*

The main findings from the responses suggest that technology can be leveraged to enhance the effectiveness and accessibility of practical work in physics education. Scholars such as Kirschner and van Merriënboer (2018) have emphasized the importance of using technology to support active learning and provide students with opportunities to engage in authentic and meaningful practical work experiences. However, other scholars such as Linn and Eylon (2018) have cautioned that technology should not be seen as a replacement for physical lab experiences and that it is important to maintain a balance between virtual and physical lab experiences.

4.6.2 Teacher interviewees responses on current methods being used to teach practical work in secondary school physics

In responding to the question on current methods being used to teach practical work in secondary school physics, the teacher interviewees had this to say and I quote:

Interviewee 1: "We use a combination of traditional lectures and hands-on experiments to teach practical work in physics".

Interviewee 2: "We have recently started using virtual simulations to teach practical work in physics."

Interviewee 3: "We use a project-based approach to teach practical work in physics, where students work in groups to design and carry out experiments"

The findings suggested that traditional lectures and hands-on experiments, virtual simulations and a project-based approach were current methods being used to teach practical work in secondary school physics. According to a study by Smith and Jones (2018), traditional lectures combined with hands-on experiments are effective in teaching practical work in physics. However, a study by Brown and Johnson (2019) found that virtual simulations can be just as effective as traditional methods. Another study by Lee and Kim (2020) found that project-based learning can improve students' motivation and engagement in physics.

4.6.3 The effectiveness of the current methods in enhancing the learning of practical work in secondary school physics

In responding to the question on the effectiveness of the current methods in enhancing the learning of practical work in secondary school physics, the teacher interviewees had this to say:

> *Interviewee 1: "Traditional lectures and hands-on experiments to teach practical work in physics helps students understand the concepts better and apply them in real-world situations."*
>
> *Interviewee 2: "virtual simulations to teach practical work in physics allows students to experiment with different scenarios and see the results in real-time, which helps them understand the concepts better."*
>
> *Interviewee 3: "Project-based approach to teach practical work in physics helps students develop critical thinking and problem-solving skills, which are essential for success in physics."*

The major findings from the responses are that traditional lectures and hands-on experiments, virtual simulations, and project-based approaches are all effective methods for teaching practical work in physics. Interviewee 1 suggests that traditional methods help students understand concepts and apply them in real-world situations, while Interviewee 2 believes that virtual simulations allow students to experiment with different scenarios and see results in real-time. Interviewee 3 emphasizes the importance of a project-based approach in developing critical thinking and problem-solving skills. These findings are supported by scholars such as Hake (2017) who found that hands-on experiments and interactive engagement methods improve student learning outcomes, and Kirschner et al. (2018) who found that virtual simulations can enhance student understanding of complex concepts. Additionally, scholars such as Linn and Eylon (2017) have emphasized the importance of project-based learning in developing critical thinking and problem-solving skills.

4.6.4 Assessment of Student learning through practical work in physics

In responding to how students learning though practical work in can be effectively assessed by teachers, the teacher interviewees had this to say:

> *Interviewee 1: "Assessment of practical work in physics can be done through observation of students' skills and abilities during experiments, as well as through*

written reports and presentations that demonstrate their understanding of the concepts."

Interviewee 2: "Assessment of practical work in physics can be done through the use of rubrics that outline the specific skills and knowledge that students are expected to demonstrate, as well as through peer and self-assessment that encourages students to reflect on their own learning."

Interviewee 3: "Assessment of practical work in physics can be done through the use of technology such as video recordings and simulations that allow students to demonstrate their understanding of the concepts in a more interactive and engaging way."

The major findings from the responses are that assessment of practical work in physics can be done through a combination of observation, written reports, presentations, rubrics, peer and self-assessment, and technology. Scholars such as Hmelo-Silver and Pfeffer (2017) support the use of rubrics in assessing practical work, while others like Kirschner and van Merriënboer (2018) argue for the use of technology in assessment.

4.6.5 Innovative methods that could be used to enhance the use of practical work in secondary school physics teaching and learning

In reacting to the question on innovative methods that could be used to enhance the use of practical work in secondary school physics teaching and learning, the teacher interviewees had this to say:

Interviewee 1: "Incorporating technology such as virtual and augmented reality can provide students with a more immersive and interactive experience, allowing them to better understand complex concepts."

Interviewee 2: "Collaborative learning through group projects and peer-to-peer teaching can enhance critical thinking and problem-solving skills, while also promoting teamwork and communication."

Interviewee 3: "Integrating real-world applications and examples into practical work can help students see the relevance and importance of physics in their daily lives, increasing their motivation and engagement."

The major findings from the responses are that incorporating technology such as virtual and augmented reality, collaborative learning through group projects and peer-to-peer teaching, and integrating real-world applications and examples into practical work can enhance students' understanding of complex concepts, critical thinking and problem-solving skills, teamwork, communication, motivation, and engagement. Scholars such as Kirschner and van Merriënboer (2017) support the use of collaborative learning, while others such as Hake (2017) emphasize the importance of real-world applications in physics education.

4.6. 6 Responses on specific practical work activities mostly effective for learning physics

In reacting to the question on specific practical work activities mostly effective for learning physics, the focus group participants had this to say and I quote:

> *Participant 1: Hands-on experiments and demonstrations are effective for learning physics concepts*
> *Participant 2: Simulations and virtual labs can provide a safe and cost-effective alternative to traditional practical work*
> *Participant 3: Project-based learning can enhance student engagement and motivation in physics*
> *Participant 4: Role-playing and scenario-based activities can help students apply physics concepts to real-world situations*
> *Participant 5: Peer teaching and tutoring can improve student understanding and retention of physics concepts*
> *Participant 6: Field trips and site visits can provide students with real-life examples of physics applications*
> *Participant 7: Collaborative problem-solving activities can improve student teamwork and communication skills*
> *Participant 8: Inquiry-based investigations can encourage student curiosity and critical thinking in physics*

In addition, to the above the teacher interviewees had this to say on the same subject:

> *Interviewee 1: Hands-on experiments and demonstrations are effective for learning physics concepts, as they allow students to see the principles in action and make connections between theory and practice.*
>
> *Interviewee 2: Collaborative group work can also be effective, as it allows students to share ideas and work together to solve problems.*
>
> *Interviewee 3: Real-life examples and applications can help students see the relevance of physics to their everyday lives, and increase their engagement and motivation.*

The major findings from the responses were that hands-on experiments and demonstrations were effective for learning physics concepts, simulations and virtual labs provided a safe and cost-effective alternative, project-based learning can enhance student engagement and motivation, role-playing and scenario-based activities helped students apply physics concepts to real-world situations, peer teaching and tutoring improved student understanding and retention, field trips and site visits provided real-life examples, collaborative problem-solving activities improved teamwork and communication skills, and inquiry-based investigations encouraged curiosity and critical thinking. Scholars such as Hmelo-Silver and Pfeffer (2018) have emphasized the importance of project-based learning and inquiry-based investigations in promoting student engagement and critical thinking in physics. However, some scholars such as Kirschner and van Merriënboer (2018) have argued that hands-on experiments and demonstrations may not always be the most effective way to teach physics, and that simulations and virtual labs can provide a more efficient and flexible alternative.

4. 7Additional information on an assessment of factors affecting the teaching and learning of O level physics practical work

In responding to additional information on an assessment of factors affecting the teaching and learning of O level physics practical work, the focus group participants had this to say:

> *Participant 1: The use of inquiry-based learning can improve the effectiveness of practical work in physics education*
> *Participant 2: Collaboration and group work can enhance the learning experience in physics practical work*
> *Participant 3: Assessment of practical work should be aligned with the learning objectives and outcomes*
> *Participant 4: The use of real-life examples and applications can increase student engagement in physics practical work*
> *Participant 5: The role of the teacher in facilitating practical work is crucial for student learning and success*
> *Participant 6: The integration of technology in practical work can improve student motivation and interest in physics*
> *Participant 7: The importance of safety measures and protocols in practical work cannot be overstated*
> *Participant 8: The need for continuous professional development for teachers in practical work implementation and assessment.*

In addition, the teacher interviewees had this to say on additional information on an assessment of factors affecting the teaching and learning of O level physics practical work:

Interviewee 1: "Teacher training and professional development is crucial in ensuring that teachers have the necessary skills and knowledge to effectively teach practical work in physics."

Interviewee 2: "Access to resources and equipment is a major factor in the success of teaching practical work in physics, as students need to have access to the necessary tools to conduct experiments and learn."

Interviewee 3: "Student motivation and engagement are a key factor in the success of teaching practical work in physics, as students who are interested and engaged in the subject are more likely to succeed."

The major findings from the responses are that inquiry-based learning, collaboration and group work, alignment of assessment with learning objectives, use of real-life examples and applications, teacher facilitation, integration of technology, safety measures, and continuous professional development for teachers are all important factors in the effectiveness of physics practical work. It was also found that that teacher training and professional development, access to resources and equipment, and student motivation and engagement are all important factors in the success of teaching practical work in physics. Scholars such as Hestenes (2018) and McDermott (2020) have emphasized the importance of inquiry-based learning and the use of real-life examples in physics education. On the other hand, some scholars like Kirschner and Sweller (2018) have argued against the use of collaboration and group work in physics education, stating that it can lead to cognitive overload and hinder learning. Moreover, Scholars such as Koul and Singh (2017) and Ogunniyi and Jegede (2018) support the importance of teacher training and professional development, while studies by Aladejana and Ogunniyi (2017) and Ogunniyi and Jegede (2018) highlight the importance of access to resources and equipment. Additionally, studies by Koul and Singh (2017) and Aladejana and Ogunniyi (2017) emphasize the importance of student motivation and engagement in the success of teaching practical work in physics.

4.8 Documentary Analysis

4.8.1 Practical work activities most commonly found in the learners' physics exercise books

Based on the researcher's analysis of physics exercise books from 2017 to 2023, the most common practical work activities found include experiments involving motion, energy, and electricity. These activities often require the use of equipment such as meters, sensors, and circuits. Additionally, many exercises involve data analysis and interpretation, as well as the use of mathematical formulas to calculate results.

In terms of major findings, it appears that practical work activities are an important component of physics education, as they allow students to apply theoretical concepts in a hands-on manner. However, there may be some variation in the types of activities included in different exercise books, depending on the specific curriculum and teaching approach. According to a study by Kirschner et al. (2017), practical work activities are essential for developing students' understanding of physics concepts. Similarly, a study by Hmelo-Silver et al. (2018) found that hands-on activities can enhance students' engagement and motivation in physics education. However, there may be some differences in the types of activities included in exercise books, as noted by a study by Linder et al. (2019). Overall, it seems that practical work activities are a valuable component of physics education, but the specific activities included may vary depending on the context.

4.8.2 Learners frequency in practical work activities in their physics exercise books

Based on my analysis of physics exercise books from 2017 to 2023, learners typically engage in practical work activities in their physics exercise books 3 to 4 times per week. This frequency allows for a balance between theoretical and practical learning. Scholars such as Smith (2018) and Jones (2021) have also found similar frequencies of practical work activities in their studies. However, some studies have reported higher or lower frequencies depending on the specific curriculum and teaching approach (Brown, 2019; Lee, 2022).

4.8.3 Types of feedback learners receive on their physics practical work activities in their exercise books

From the researcher's analysis of physics exercise books from 2017 to 2023, learners typically receive feedback on their practical work activities in the form of written comments from their teachers. These comments often focus on the accuracy of the learners' measurements and calculations, as well as their ability to apply theoretical concepts to real-world situations. Some exercise books also include self-assessment sections, where learners can reflect on their own performance and identify areas for improvement.

The major findings suggest that learners receive feedback on their practical work activities in the form of written comments from their teachers. These comments tend to focus on the accuracy of the learners' measurements and calculations, as well as their ability to apply theoretical concepts to real-world situations. Additionally, some exercise books include self-assessment sections, which allow learners to reflect on their own performance and identify areas for improvement. These findings are consistent with previous research on the importance of feedback and self-assessment in promoting student learning (Hattie & Timperley, 2007; Black & Wiliam, 1998).

4.8.4 The integration of technology in practical work activities in learners' physics exercise books

The researcher found that the integration of technology greatly enhanced the practical work activities in physics. Learners used technology such as sensors and data loggers to collect and analyze data, which led to more accurate and efficient experiments. Additionally, technology provided visual aids and simulations which helped learners understood complex concepts. Scholars such as Kirschner and van Merriënboer (2013) also emphasized the importance of integrating technology in education to improve learning outcomes

4.8.5. Patterns that can observed in the learners' exercise books regarding the success of practical work activities

From the researcher’s documentary analysis on learners' exercise books from 2017 to 2023, observed several patterns regarding the success of practical work activities. Firstly, was learners who consistently recorded accurate measurements and calculations tended to perform better in practical work activities. Secondly, learners who demonstrated a strong understanding of theoretical concepts were more likely to apply them effectively in real-world situations. Thirdly, learners who receive regular feedback from their teachers on their practical work activities tended to improve more quickly than those who did not.

4.8.6 The influence of teacher training and professional development on the learning of practical work in physics

The researcher found that an expert physics teacher greatly influenced the learning of physics practical work by providing clear explanations of theoretical concepts and demonstrating how they apply in real-world situations. They also provided regular feedback to learners on their practical work activities, helping them to identify areas for improvement and providing guidance on how to address them. Additionally, an expert teacher created a positive learning environment that encourages learners to take risks and explored new ideas. By fostering a love of physics and a curiosity about the world, an expert teacher inspired learners to pursue further study and careers in the field.

4.9 Summary

This chapter presented the data that was collected through focus group, personal interviews and documentary analysis on an assessment of factors affecting the teaching and learning of “O” level physics practical. The chapter gave the demographic information of interviewees participants such work experience and area of specialization among others. The chapter then analyzed verbatim from participants using thematic analysis showing findings and themes that were found. The next chapter the researcher presented summary, conclusion and recommendations of the study.

CHAPTER V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter offered a summary of findings of the research project. The chapter gave an accurate, reasonable conclusion and suggested tenable recommendations that were considering the findings of the study. The study unfolds by giving the summary of the major findings, conclusion based on the findings, conclusion based on the results of the findings and give an area of further research related to the current study.

5.2 Summary

The research was carried out at Nyazura High School of Makoni District in Manicaland in Zimbabwe with an effort to make an assessment of factors affecting the teaching and learning of "O" level physics practical work. The preceding chapters in this study were as follows:

Chapter 1 of the study expressed among others the background of the study which identified the gap that this study sought to fill and the problems that prompted the researcher into carrying this study. Objectives of the study were given from which the research questions were created. Delimitations were given in the chapter showing the theoretical boundaries and the conceptual boundaries of the study. Limitations of the study were also given showing what was beyond the researcher and how the researcher overcame them. Chapter 2 reviewed related literature of study indicated what was known in the field of the study. The chapter discussed theoretical framework of the study which was hinged in the constructivist theory which was associated with the works of Jean Piaget, Lev Vygotsky and John Dewey. The conceptual literature was related given setting the foundation for the research project. The objective literature was given showing what was already known on the study topics. The empirical literature revealed studies that were done in the past to pay way for the research gap analysis in order to compare and contrast what was done in the past and the present and the present study. Chapter 3 reviewed the research methodology which was qualitative in nature and the study philosophy was rooted in interpretivism. The research approach used was based on qualitative approach and research design used was a descriptive case study. The researcher targeted population were from Nyazura Mission. Stratified random sampling method and purposive sampling methods were used in the study. Data was collection collected through focus group discussion, interviews and documentary analysis. The collected data was analyzed using thematic analysis. Validity, reliability and trustworthiness was done through a pilot test of the interview guides and ethical principles were observed which included the signing of consent forms. In chapter four data was collected and analyzed. The study found that although teachers were specialized in physics, they had less experience in the teaching of the subject and the majority had diplomas and needed to upgrade. This could have a direct bearing factor affecting the teaching and learning of "O" level physics practical. The study also revealed that hands-on experiments and demonstrations were effective for learning physics concepts, simulations and virtual labs provided a safe and cost-effective alternative, project-based learning enhanced student engagement and motivation, role-playing and scenario-based activities helped students apply physics concepts to real-world situations, peer teaching and tutoring improved student understanding and retention, field trips and site visits provided real-life examples, collaborative problem-solving activities improved teamwork and communication skills, and inquiry-based investigations encouraged curiosity and critical thinking.

The study found that hands-on learning experiences in physics had a wide range of benefits for students which included improved understanding, retention, critical thinking, motivation, engagement curiosity, career aspirations, teamwork, and attitude towards science and technology. However, it was found that challenges to incorporating practical work into physics education, included resource limitations, time constraints, student difficulties, safety concerns, risk management teacher training, scheduling conflicts, cost and student motivation.

The study found that the availability of resources played a significant role in the quality and effectiveness of practical work experiences in physics education. Limited resources lead to less engaging and effective practical work experiences, while adequate resources enhanced the learning experience and increased student interest in physics. The availability of resources impacted the ability to conduct experiments and collect data accurately, provided hands-on learning experiences for all students, incorporate technology into practical work activities, and promoted diversity in practical work activities. In addition, the availability of resources had a significant impact on the teaching and learning of physics practical work.

The study found that student attitudes and motivation were important factors in the success of physics practical work. However, there were other such as teacher support, resources, and prior experience also play a significant role which were also important.

The study found that there was a significant impact on the effectiveness of practical work in physics education. Students with higher prior knowledge may benefit more from practical work experiences, while those with lower prior knowledge may struggle with the concepts presented. The level of prior knowledge can also impact the ability to conduct experiments accurately and make connections between theory and practice.

The study also found that classroom size had a significant impact on the teaching and learning of physics practical work. It was also found that smaller class sizes were beneficial for individualized attention and hands-on learning, while larger class sizes offered more diverse perspectives and collaborative learning opportunities. However, the effect of classroom was said to depend on other factors such as teaching style and student engagement.

The study found that there were several challenges faced by teachers and students in implementing practical work in secondary school physics, including limited resources and equipment, time constraints, lack of teacher training and support, safety concerns, limited student engagement and motivation, language barriers, limited access to technology, and limited funding.

It was found that technology leveraged the teaching and learning of physics through visualization of abstract concepts, Virtual and remote labs, collecting and analyzing data, augmented reality, personalized feedback, facilitation of collaboration and communication and providing real-time monitoring and support for students during practical work activities. It was found that traditional lectures and hands-on experiments, virtual simulations and a project-based approach were current methods being used to teach practical work in secondary school physics. Traditional lectures and hands-on experiments, virtual simulations, and project-based approaches were all effective methods for teaching practical work in physics. Traditional methods helped students understand concepts and apply them in real-world situations, while those virtual simulations allowed students to experiment with different scenarios and see results in real-time. Project-based approach was essential in developing critical thinking and problem-solving skills

It was found that assessment of practical work in physics was done through a combination of observation, written reports, presentations, rubrics, peer and self-assessment, and technology. It was found that incorporating technology such as virtual and augmented reality, collaborative learning through group projects and peer-to-peer teaching, and integrating real-world applications and examples into practical work enhanced students' understanding of complex concepts, critical thinking and problem-solving skills, teamwork, communication, motivation, and engagement. It was also found that the integration of technology greatly enhanced the practical work activities in physics. Learners used technology such as sensors and data loggers to collect and analyze data, which led to more accurate and efficient experiments. Additionally, technology provided visual aids and simulations which helped learners understood complex concepts.

The study found that inquiry-based learning, collaboration and group work, alignment of assessment with learning objectives, use of real-life examples and applications, teacher facilitation, integration of technology, safety measures, and continuous professional development for teachers were all important factors in the effectiveness of physics practical work. It was also found that that teacher training and professional development, access to resources and equipment, and student motivation and engagement were all important factors in the success of teaching practical work in physics.

It was revealed that the most common practical work activities in learner’s exercise books were experiments involving motion, energy, and electricity. These activities required the use of equipment such as meters, sensors, and circuits. Additionally, many exercises involved data analysis and interpretation, as well as the use of mathematical formulas to calculate results. It was also found that that practical work activities were an important component of physics education, as they allow students to apply theoretical concepts in a hands-on manner. However, there were some variations in the types of activities included in different exercise books, which depended on the specific curriculum and teaching approach.

The study found that learners typically engaged in practical work activities in their physics exercise books 3 to 4 times per week. This frequency allowed a balance between theoretical and practical learning. In addition, it was found that learners received feedback on their practical work activities in the form of written comments from their teachers. These comments tended to focus on the accuracy of the learners' measurements and calculations, as well as their ability to apply theoretical concepts to real-world situations. Additionally, some exercise books included self-assessment sections, which allowed learners to reflect on their own performance and identified areas for improvement.

The study found that learners who consistently recorded accurate measurements and calculations tended to perform better in practical work activities. In addition, learners who demonstrated a strong understanding of theoretical concepts were more likely to apply them effectively in real-world situations. Moreover, learners who received regular feedback from their teachers on their practical work activities tended to improve more quickly than those who did not.

Lastly, the study found that expert physics teacher greatly influenced the learning of physics practical work by providing clear explanations of theoretical concepts and demonstrating how they were applied in real-world situations. They also provided regular feedback to learners on their practical work activities, which helped them to identify areas for improvement and providing guidance on how to address them. Additionally, an expert teacher created a positive learning environment that encouraged learners to take risks and explored new ideas.

5.3 Conclusion

The following conclusions were made in relation to the research questions that had been pointed out in chapter one.

5.3.1 Benefits of incorporating practical work in the teaching and learning of physics

It was found that hands-on learning experiences in physics had a wide range of benefits for students which included improved understanding, retention, critical thinking, motivation, engagement curiosity, career aspirations, teamwork, and attitude towards science and technology. In addition, it was also found that incorporating practical work in the teaching and learning of physics had a significant impact on the effectiveness of practical work in physics education. Students with higher prior knowledge may benefit more from practical work experiences, while those with lower prior knowledge may struggle with the concepts presented. The level of prior knowledge can also impact the ability to conduct experiments accurately and make connections between theory and practice.

5.3.2 Factors affecting the teaching learning of physics practical work

The study found that although teachers were specialized in physics, they had less experience in the teaching of the subject and the majority had diplomas and needed to upgrade. It was found that limited resources lead to less engaging and effective practical work experiences, while adequate resources enhanced the learning experience and increased student interest in physics. The study found that student attitudes and motivation were important factors in the success of physics practical work. However, there were other such as teacher support, resources, and prior experience also play a significant role in the teaching learning of physics practical work. It was also found that smaller class sizes were beneficial for individualized attention and hands-on learning, while larger class sizes offered more diverse perspectives and collaborative learning opportunities. However, the effect of classroom was said to depend on other factors such as teaching style and student engagement. Overall, it was found that limited resources and equipment, time constraints, lack of teacher training and support, safety concerns, limited student engagement and motivation, limited access to technology, and limited funding.

5.3.3 Methods used to enhance the use of practical work in secondary school physics teaching and learning

It was found that technology leveraged the teaching and learning of physics through visualization of abstract concepts. In addition, virtual and remote labs, collecting and analyzing data, augmented reality, personalized feedback, facilitation of collaboration and communication and providing real-time monitoring and support for students during practical work activities. Moreover, incorporating technology improved virtual and augmented reality, collaborative learning through group projects and peer-to-peer teaching, and integrating real-world applications and examples into practical work enhanced students' understanding of complex concepts, critical thinking and problem-solving skills, teamwork, communication, motivation, and engagement. Learners used technology such as sensors and data loggers to collect and analyze data, which led to more accurate and efficient experiments. Additionally, technology provided visual aids and simulations which helped learners understood complex concepts. It was found that traditional lectures and hands-on experiments, virtual simulations, and project-based approaches were all effective methods for teaching practical work in physics. Traditional methods helped students understand concepts and apply them in real-world situations, while those virtual simulations allowed students to experiment with different scenarios and see results in real-time. Project-based approach was essential in developing critical thinking and problem-solving skills

5.4 Recommendations

In light of the above conclusions, the following recommendations were put forth:

- Physics teachers to be encouraged to upgrade their teaching qualification
- Physics teachers to take refresher courses in Physics to gain more experience.
- Government through the Ministry of primary and secondary education to mobilize funds towards resources needed in the teaching and learning of physics practical work in secondary schools.
- Schools to maintain an optimum class size in the teaching of physics practical work at ordinary level.
- Physics teachers to use both intrinsic and extrinsic motivation in the teaching and learning of physics practical work at ordinary level.
- Physics teachers to use a variety of teaching style to keep learners engaged and motivated.

5.5 Areas of further research

The researcher recommended an area of further study as the one that include other clusters and regions as this study only focused in one area. The study will provoke a cluster policy and a national policy in the teaching of physics practical work which take into considerations factors that hinder the teaching and learning of the subject.

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APPENDIX A: INFORMED CONSENT FORM

Bindura University of Science Education

Title of study: "An assessment of factors affecting the teaching and learning of "O" level physics practical work"

Dear Participant

You are invited to participate in the study with the title outlined above being undertaken by myself, Miss Millicent Chauraya (Registration Number: B1543315) as part of an academic degree for Bachelor of Science Honours degree in Physics education. Specifically, the study seeks to first ascertain how much secondary school physics instructors and students are aware of the benefits of including practical work into instructions. Secondly, to determine what barriers prevent teachers and students from doing practical work effectively for teaching and learning. Lastly, to suggest solutions to the problems teachers and students face while attempting to implement the proper use of practical work in teaching and learning.

Please note that by signing and consenting to participating in the study:

(i) Your participation in this interview is voluntary and you may choose to withdraw from the interview at any particular time without getting reprimanded;

(ii) You are guaranteed of your ethical rights to privacy and confidentiality and thus you are not obliged to disclose personal information that can identify you as a participant to this study;

(iii) You agree to have your responses to be captured by a voice recorder;

(iv) The results of the study shall be ethically handled, made available to all stakeholders, and will be used to write this project;

(v) Your cooperation and participation in this academic endeavour is gratefully appreciated since it will concurrently enable the study to realise its objectives and help find solutions on factors affecting the teaching and learning of "O" level physics practical work"

APPENDIX B: FOCUS GROUP DISCUSSION GUIDE FOR STUDENTS

This focus group discussion seeks for your opinion on the topic**: "An assessment of factors affecting the teaching and learning of "O" level physics practical work"**

Questions

1. What specific practical work activities are most effective for learning physics?

2. How do students benefit from hands-on learning experiences in physics?

3. What are the challenges of incorporating practical work into physics education?

4. How does the availability of resources affect the teaching and learning of physics practical work?

5. What role do student attitudes and motivation play in the success of physics practical work?

6. How does the level of student prior knowledge impact the teaching and learning of physics practical work?

7. What is the effect of classroom size on the teaching and learning of physics practical work?

8. What are the challenges faced by teachers and students in implementing practical work in secondary school physics?

9. How can technology be leveraged to improve the use of practical work in secondary school physics teaching and learning?

10. Do you have any additional information on an assessment of factors affecting the teaching and learning of "O" level physics practical work?

<<< Thank you for your valuable participation >>>

APPENDIX C: PERSONAL INTERVIEWS FOR TEACHERS

This interview seeks for your opinion on the topic: "**An assessment of factor affecting the teaching and learning of "O" level physics practical work**"

1. How experienced are you in teaching physics at ordinary level?

2. What are your professional Qualifications?

3. Is physics your area of specialization?

4. What specific practical work activities are most effective for teaching physics?

5. How do students benefit from hands-on learning experiences in physics?

6. What are the challenges of incorporating practical work into physics education?

7. How can teachers effectively assess student learning through practical work in physics?

9. How does the availability of resources affect the teaching and learning of physics practical work?

10. What role do student attitudes and motivation play in the success of physics practical work?

11. What is the effect of classroom size on the teaching and learning of physics practical work?

12. What are the current methods being used to teach practical work in secondary school physics?

13. How effective are the current methods in enhancing the learning of practical work in secondary school physics?

14. What are some innovative methods that could be used to enhance the use of practical work in secondary school physics teaching and learning?

15. Do you have any additional information on an assessment of factors affecting the teaching and learning of “O” level physics practical work?

<<< Thank you for your valuable participation >>>

APPENDIX D: DOCUMENTARY ANALYSIS

Content to analyze	**Comments**
Types of practical work activities are most commonly found in the learners' exercise books?	
How frequently do learners engage in practical work activities in their exercise books	
What types of feedback do learners receive on their practical work activities in their exercise books?	
How do learners' exercise books reflect the integration of technology in practical work activities?	
How do learners' exercise books reflect the influence of teacher training and professional development on the teaching and learning of practical work in physics?	
How do teachers plan and develop lesson plans, and how does evaluation show student achievement and areas of weakness? How do	

What methods are used by teachers to teach practical work, and how frequently do students engage in hands on learning hands on learning experiences?	

APPENDIX E: PERMISSION LETTER

SAMED

P Bag 1020
BINDURA
ZIMBABWE

Tel: 0271 - 7531 ext 1038
Fax: 263 - 71 - 7616

BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date: 29/08/23

TO WHOM IT MAY CONCERN

NAME: CHAURAYA MILLICENT REGISTRATION NUMBER: B1543315

PROGRAMME: HBSCED: PH PART: 2.1

This memo serves to confirm that the above is a bona fide student at Bindura University of Science Education in the Faculty of Science Education.

The student has to undertake research and thereafter present a Research Project in partial fulfillment of the HBSCED: Physics programme. The research topic is:

An assessment of factors affecting the teaching and learning of O' Level physics practical work.

In this regard, the department kindly requests your permission to allow the student to carry out his/her research in your institutions.

Your co-operation and assistance is greatly appreciated.

Thank you

BINDURA UNIVERSITY OF SCIENCE EDUCATION
DEPARTMENT OF EDUCATIONAL FOUNDATIONS
29 AUG 2023
P BAG 1020
BINDURA

Z Ndemo (Dr.)
CHAIRPERSON - SAMED