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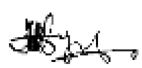
APPROVAL FORM

The undersigned confirm that they have supervised, reviewed, and recommended to Bindura University of Science Education the approval of a research thesis named: INVESTIGATING HOW PHYSICS PRACTICAL'S INFLUENCE CONCEPTUAL UNDERSTANDING OF PHYSICS.

Submitted by Denford Mudhungwe

In the partial fulfillment of the requirements for the bachelor of Science Degree in Physics.

(*Signature of student*) …………….. Date ……06/10/23……..



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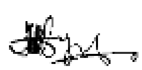

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DECLARATION FORM

I Denford Mudhungwe (B1543376), hereby certify to Bindura University of Science Education that this thesis is my original work, and that all materials and academic sources of information have been properly cited. This work has not been submitted to any other academic institution for academic merit.

DEDICATION

ACKNOWLEDGEMENTS.

ABSTRACT.

The goal of this study is to determine the impact of physics practical work on students' academic performance after implementing practical work in an experimental group. High school students from Mashonaland East Province's Mvurwi District (Rujeko High School in Glendale and Kundayi High School in Concession) participated in this study. This study included ninety (90) Form Four, Form Five, and Form Six students; forty-six (46) students were assigned to the experimental group, while the remaining forty-six (46) students were assigned to the control group. Practical work and traditional teaching methods were used to instruct the experimental and control groups, respectively. This study employed a quasi-experimental design. The Statistical Package for Social Science (SPSS) Version 22.0 was used to analyse data on students' academic achievement, and the Mann Whitney U Test was employed. Prior to treatment, there was no significant difference in academic achievement between students in both groups ($U = 899.50$, $p > 0.05$ is not significant), indicating that the group of students is homogeneous. However, there is a statistical difference in students' academic performance following the application of practical work ($U = 773.500$, $p < 0.05$ is significant). It is recommended that educators undertake practical work as frequently as feasible (once a week) and increase the time spent on practical work to improve students' knowledge of physics concepts. Physics teachers can utilize the findings to drive the design and delivery of practical activities that are relevant and meaningful to their students. The study, for example, may discover specific physics practical's that are especially helpful in developing conceptual comprehension among students in this location.

TABLE OF CONTENTS.

Contents

List of Tables.

1.0. CHAPTER ONE.

1.1. INTRODUCTION.

Physics is a basic science that supports many elements of contemporary life, including technology and energy generation. Physics, on the other hand, is sometimes seen as difficult and complex, and students may struggle to gain a mental understanding of the topic. The use of physics practicals, which are hands-on exercises that allow students to investigate and apply physical concepts in a concrete way, is one strategy that has been utilised to improve conceptual learning outcomes in physics.

Several research have been conducted to assess the efficacy of physics practicals in enhancing conceptual learning outcomes among students. (Hestenes, 1992) discovered, for example, that physics practicals can increase students' grasp of Newtonian mechanics. Similarly, (McDermott, 1996) discovered that physics labs can assist students in developing a more coherent and integrated knowledge of physics concepts.

Despite the potential benefits of physics practicals, there has been little investigation into their usefulness in the Mashonaland East Province, Mvurwi District. This is an important lacuna in the literature since the efficiency of physics practicals may be affected by factors such as cultural and socioeconomic backdrop, resource availability, and the teaching practises of physics teachers in this region.

It's time to become practical. Thus, the purpose of this project is to evaluate the impact of physics on high school pupils in Mashonaland East Province's Mvurwi District's conceptual grasp of physics. The purpose of this study is to investigate the link between physics practicals and conceptual learning outcomes in physics using a mixed-methods approach that includes questionnaires, interviews, and classroom observations. The study's findings will have ramifications for the design and implementation of physics curriculum, the professional development of physics instructors, and the promotion of conceptual learning outcomes in physics among high school students in Mashonaland East Province's Mvurwi District.

1.2. BACKGROUND OF STUDY.

Physics practicals have long been seen as a key component of physics education and learning. Students can apply theoretical principles, acquire problem-solving abilities, and engage in scientific inquiry via practical practise. Several studies have been undertaken to explore the influence of physics practicals on students' conceptual comprehension, although the majority of these studies have been conducted in industrialised nations, with less research conducted in developing countries such as Zimbabwe.

The Ministry of Primary and Secondary Education (MoPSE) in Zimbabwe has emphasised the significance of practical practise in physics education. However, little is known about how physics practicals affect students' conceptual comprehension in Zimbabwe, notably in Mashonaland East Province's Mvurwi area. As a result, the purpose of this study is to explore the impact of physics practicals on students' conceptual comprehension in this specific setting.

Several studies have emphasised the significance of practical activity in physics education. For example, Abd-El-Khalick (2000) discovered that practical activity improved students' knowledge of scientific topics. Similarly, (1 Hodson D., 1990) contended that practical activity can assist students in developing a deeper comprehension of scientific concepts. Furthermore, research has demonstrated that practical work may increase students' problem-solving abilities and foster inquiry-based learning (1 Hofstein, 2004; Hodson D., 1993).

In conclusion, the study on "How physics practical's influence conceptual understanding of physics in Mashonaland East Province in Mvurwi district" is significant because it will give insights into the usefulness of physics practical's in Zimbabwean schools. The study's findings will be valuable in enhancing physics teaching and learning in Zimbabwe and other underdeveloped countries.

1.3. PROBLEM STATEMENT.

While physics practicals are recognised as an important component in physics teaching and learning, there is a paucity of study on how practical work improves students' conceptual knowledge in Zimbabwe, particularly in Mashonaland East Province's Mvurwi area. The Zimbabwe Ministry of Primary and Secondary Education (MoPSE) has emphasised the significance of practical work in physics education, however it is unclear whether this emphasis translates into improved student learning results. As a result, it is necessary to evaluate the impact of physics practicals on students' conceptual comprehension in this specific setting.

Previous studies on the effects of practical work in physics instruction have primarily been undertaken in rich nations, leaving a void in the literature on the effectiveness of practical work in developing countries such as Zimbabwe. Furthermore, there is no information on how much practical work physics teachers in Zimbabwe use in their classes and if they are appropriately equipped to deliver practical work efficiently.

Thus, the issue statement is to research the impact of physics practicals on students' conceptual comprehension in Mashonaland East Province's Mvurwi area, as well as to evaluate the extent to which physics teachers use practical work in their teaching. The research will also look into the effectiveness of teacher training in providing practical work.

1.4. RESEARCH QUESTIONS.

- To what extent do physics practical’s influence students' conceptual understanding of physics in Mashonaland East Province in Mvurwi district?
- What is the extent of physics teachers' utilization of practical work in their teaching in Mashonaland East Province in Mvurwi district?
- What is the adequacy of physics teacher training in delivering practical work effectively in Mashonaland East Province in Mvurwi district?

1.5. AIMS.

These research entails to investigate the effectiveness of physics practical’s in improving students' conceptual understanding of physics in Mashonaland East Province in Mvurwi district, the extent to which physics teachers utilize practical work in their teaching, and the adequacy of teacher training in delivering practical work effectively.

1.6. OBJECTIVES.

- To determine the extent to which physics practical’s improve students' conceptual understanding of physics in Mashonaland East Province in Mvurwi district.

- To investigate the factors that influence physics teachers' utilization of practical work in their teaching in Mashonaland East Province in Mvurwi district.
- To assess the adequacy of physics teacher training in delivering practical work effectively in Mashonaland East Province in Mvurwi district.

These objectives aim to provide a comprehensive understanding of the influence of physics practical’s on students' conceptual understanding of physics in Mashonaland East Province in Mvurwi district, the factors that affect the utilization of practical work in teaching, and the adequacy of teacher training in delivering effective practical work.

1.7. SIGNIFICANCE OF STUDY.

- Contribution to knowledge: The study will contribute to the existing body of knowledge on the effectiveness of physics practical’s in improving students' conceptual understanding of physics in Zimbabwe. The study will also provide insights into the factors that affect the utilization of practical work in teaching and the adequacy of teacher training in delivering effective practical work.
- Improvement of physics teaching and learning: The findings of this study will be useful in improving physics teaching and learning in Zimbabwean schools. The study will provide evidence-based recommendations for the effective use of practical work in physics teaching and will inform teacher training programs on the importance of practical work in teaching physics.
- Policy implications: The study will have policy implications for the Ministry of Primary and Secondary Education in Zimbabwe. The findings of the study will inform policy formulation and implementation on the use of practical work in teaching physics in Zimbabwean schools.
- Contextualization of research: This study will provide insights into the effectiveness of physics practical’s in improving students' conceptual understanding of physics in Mashonaland East Province in the Mvurwi district. The study will provide a contextualized understanding of the use of practical work in physics teaching in Zimbabwe, which is lacking in the literature.

1.8. DELIMITATION.

Sample size: The sample size of the study may be limited due to time and resource constraints. The study may not include all schools in Mashonaland East Province in Mvurwi district.

Time frame: The study will be conducted within a specific time frame, which may limit the depth and scope of the research. The study may not be able to capture long-term effects of practical work on students' conceptual understanding of physics.

Language: The study will be conducted in English, which may limit the participation of non-English speaking physics teachers and students.

Availability of data: The study will rely on data collected from physics teachers and students in Mashonaland East Province in Mvurwi district. The availability and quality of data may be affected by factors such as teacher and student participation, data collection methods, and response bias.

1.9. DEFINITION OF TERMS.

- Practical work: refers to any type of science teaching and learning activity in which students, working either individually or in small groups, are involved, as an important element of what they are doing, in manipulating and/or observing real objects and materials as opposed to virtual objects and materials such as those obtained from a DVD, a computer simulation or even from a text-based account (Abrahams et al., 2013).

2.0. CHAPTER TWO: LITERATURE REVIEW.

2.1. INTRODUCTION.

Education is critical to the growth of a country and the globe, and Sub-Saharan African countries are working hard to change away from conventional systems in which the teacher functions as the sage of the stage in teaching and learning processes. Understanding the nature of science (NOS), or how and why science works, is a primary objective of scientific education (McComas & Clough, 2020; Nouri et al., 2021; Olson, 2018). 2022) (Valente et al. As a result, in secondary schools nowadays, learning techniques that substantially involve learners' active engagement in learning activities are critical (Niyitanga et al., 2021). Many students have the idea that sciences are tough subjects. Methods that assist learners in constructing their learning are advocated in teaching and learning initiatives to eliminate this misconception (Türkmen et al., 2007; Uwizeyimana et al., 2018). Prior study has claimed that teaching through practical labour helps encourage learners' self-learning and help them master sciences, particularly physics (Abrahams & Reiss, 2012). These researchers' findings reinforce the growing agreement among educators that laboratory experience is a crucial aspect of scientific education (Moosvi et al., 2023).

2.2. Teaching Science at secondary education level.

The conventional teaching technique is characterised as one in which the teacher teaches the topic and the students just sit, read, perform assignments, and take notes (Ates & Eryilmaz, 2011). Traditional teaching classes resemble a one-person show, with direct and one-party instruction (Abida & Muhammad, 2012). Simultaneously, pupils are passively accepting material from teachers (Liu, 2014) and without challenging the teacher (Salmiza & Afik, 2012).

Improving Physics learning and accomplishment necessitates a significant amount of involvement from instructors, as the role of the teacher in the classroom is critical. A teacher's teaching strategy and the materials with which he or she teaches are elements that can influence students' accomplishment (Mills, 1991). As a result, effective teaching equipment and methods are important to the successful teaching and learning of Physics. Despite research analysing various teaching methodologies used in Physics classes, Bello (2011) discovered that employing a small group cooperative teaching style increased students' learning in Physics. This strategy also raised students' enthusiasm to study, and it was discovered that below-average pupils improved on their results more than in traditional instruction. The cooperative idea mapping approach teaching technique improved secondary school science instruction (Orora, Wachanga, & Keraro, 2005). Furthermore, Kibett and Kathuri (2005) discovered that students who were taught using a project-based learning method outperformed their counterparts who were taught using a traditional teaching strategy. Much work has to be done in terms of making the most use of current instructional tools. As a result, the purpose of this research was to discover the accessible and used Physics laboratory equipment, as well as its impact on students' Physics accomplishment (Olufunke, 2012).

When students participate in learning activities, students-centered teaching approaches enhance face-to-face connection, group discussion, deep personal participation, open communication, and focus their attention on the topic. The focus of action shifts from the teacher to the students, who actively digest knowledge and frequently employ materials and tools such as actual materials and virtual assistance. It so enables people to learn from their own active information processing by mixing content and expertise (Ojo et al., 2020).

David Kolb's (1984) experiential learning theory describes knowledge as being created via effective and intentional hands-on materials. Experiential learning is an educational technique in which students gain information by their experiences during the learning process. Kolb's experiential learning model, which supported experience as the source of learning and growth, was initially published in 1984 and had a significant influence on the design and development of long-term learning models. Experiential learning is the process through which information and abilities are acquired by observation, exploration, and hands-on experience: learning by doing. Effective learning occurs when a person goes through four stages: having a concrete experience, observing and reflecting on that experience, which leads to the formation of abstract concepts (analysis), and generalisations (conclusions), which are then used to test hypotheses in future situations, resulting in new experiences. Diverging (feeling and seeing) emphasises the inventive and imaginative way to accomplishing things in the model. Views concrete events from a variety of angles and adjusts via observation rather than action. Assimilation (seeing and thinking) combines a variety of observations and thoughts into a cohesive whole. Converging (doing and thinking) focuses on the practical application of concepts and problem solutions. It promotes decision-making, problem-solving, and idea implementation. Trial and error, rather than thought and deliberation, are used in accommodating (doing and experiencing). Solves issues intuitively via trial and error, as in discovery learning.

Activity-based teaching techniques are student-centered instructional tactics that promote active learning by having students write, discuss, describe, explain, and reflect on processes that would not ordinarily occur in a regular classroom. They are designed to immerse students in experiences that allow them to participate in meaning-making inquiry, action, creativity, innovation, interaction, hypothesizing, and personal reflection. Students generate knowledge and meaning by drawing on their own experiences, past knowledge, and perceptions, as well as their physical and interpersonal contexts. The objective is to create a classroom atmosphere that gives students with meaningful learning experiences (Ojo et al., 2020). Practical work is used in scientific teaching and learning in this learning strategy. Real-life occurrences allow students to analyse and test their perspectives, as well as develop their understandings prior to the learning process. Practical work provides an amazing learning environment in which students may develop their knowledge and improve their logical, inquiring, and psychomotor abilities (Mashita, Norita, & Zurida, 2009). Furthermore, practical work provides students with an engaging experience that allows them to widen the scope of constructivist learning (Umar, Ubramaniam, & Ukherjee, 2005). It is believed that having pupils do practical labour will help them grasp the actual world. Practical work entails anticipating and witnessing scientific phenomena. Predicting is the process of anticipating the probable results of an unmet occurrence based on previous experiences and facts. It is critical in scientific teaching and learning. It encourages students to use existing information and express their understanding of the topic under research. According to Kien, Gabriela, Ok-Kyeong, Francisco, and Lisa (2010), prediction serves a bridging function in assisting students in making connections between physical phenomena and associated scientific ideas. It may be a beneficial educational tool for assisting student learning in a variety of ways. Prediction helps students to activate and enhance their previous knowledge in terms of idea creation. It promotes learning by allowing students to account for discrepancies between what they expect and what they perceive (Ojo et al., 2020).

Project-based learning necessitates the active participation of students' efforts over an extended period of time. Projects may be tailored to various types of learners and learning contexts. There are several benefits and drawbacks to project-based learning (Holubova, 2008). According to our findings, the benefits of this form of education include student participation and the opportunity to tackle multidisciplinary challenges. The exercises can be completed outside of the educational setting. Projects foster collaboration, and students learn to work as researchers with a variety of tools, technologies, and materials. New teams can be formed not only from kids in one classroom, but from students throughout the school. Students are given the opportunity to display their work. We also discovered several drawbacks, such as instructors' inability and unwillingness to plan and participate on multidisciplinary projects. On the other hand, many project days are being planned at schools in accordance with the new educational programme (it is one of the mandatory results). It is more difficult to assess the work of individual member of the team.

2.3. Secondary Education of Physics.

Physics is the foundation of science and technology since many of the instruments upon which scientific and technological progress is based are direct results of Physics. Physics is thus a fundamental topic in science and technology because it explores the essence of natural events and aids individuals in understanding a quickly changing technological world (Antwi et al., 2021). Physics concepts have been widely applied in numerous economic, scientific, and technical advancements, such as information technology, which has reduced the globe to a global village through the use of satellites and computers. Furthermore, understanding of Physics has led to long-term progress in the field of industrialization for the enhancement of materials helpful to the human race's well-being. Furthermore, Physics education helps students to develop problem-solving and decision-making abilities, which prepare the way for critical thinking and inquiry, which may help them adapt to broad and profound changes in all aspects of life. Physics is an abstract science topic that relies heavily on practice, with instructional materials playing a critical role. Theoretical information is constantly accompanied by practical knowledge, which allows students to broaden their manipulative abilities and scientific attitudes (Josiah, 2013). As a result, practical activity should be promoted during physics class in order to transform students' perceptions of physics and increase success. As a result, the researcher emphasizes the impact of physics practical work on students' academic achievement in this stud (Bada & Jita, 2021).

2.4. Impact of practical work of physics education.

"...learning experience in which students interact with materials or secondary sources of data to observe and understand the natural world" (Lunetta, Hofstein, & Clough, 2007). Other terms for practical labour include experimental work and scientific studies (Ramnarain, 2011). Students study science topics through laboratory experiments, which differs from the "Chalk and Talk" technique (Lee & Sulaiman, 2018b).

Practical work is a hands-on student activity that has become a feature of the scientific curriculum in a number of nations in recent decades. Students use equipment to make observations and conclusions about real materials and how they react, which is often done in school laboratories. Practical work in scientific education is usually regarded as a good goal, and establishing favourable attitudes towards science is regarded as an essential goal (Toplis, 2012).

The fact that scientific education incorporates actual activity distinguishes it (Abrahams & Millar, 2008). The amount to which practical works are inserted and executed in the required content and skill development determines the efficacy of secondary school physics teaching and learning. Physics is often regarded as the foundation of all technology. This helps to explain why physics governs all types of technology (Harcourt, 2018). The primary goals of science in general, and physics in particular, should be development (Barret, Gardner, Joubert, & Tikly, 2019).

Practical work includes a variety of tasks such as laboratory experiments, project work, library research, fieldwork, site visits, environmental monitoring, and technology research. As a result, practical work should be done in a variety of settings rather than just the classroom or laboratory. Because practical work is one of the teaching and learning techniques that requires learners to participate rather than be passive with the confidence of performing practises (Abrahams & Reiss, 2012), it is one of the teaching and learning ways that requires learners to be active rather than passive. As a result, learners can engage in teaching and learning activities independently through observation and the problems they have posed and replies offered. Furthermore, practical work or hands-on learning in science is primarily aimed at producing learners who are capable of listening, manipulating, and seeing the desired consequences (Kibirige & Maponya, 2021). Usual practises have a considerable impact on learners' and instructors' attitudes towards science. This indicates that well-proposed and implemented "minds-on" and "hands-on" or practical activities in scientific schools may produce critical thinkers' learners who are competent in the labour market and capable of dealing with societal concerns (Niyitanga et al., 2021).

Practical activity, particularly in teaching physics, may readily meet educational objectives (P. A. M. Musasia et al., 2016). Furthermore, first-hand understanding of the physics topic will be created, allowing students to comprehend abstract concepts that are difficult to convey in class (Osborne, 2002). Practical work places students at the centre of learning, allowing them to engage in scientific topics rather than being informed about them. According to research (Babalola, Lambourne, & Swithenby, 2020), in order for students to grasp the theoretical parts of Physics taught in the classroom and apply them to real-world circumstances, they must learn the procedures of practical aspects (Lee & Sulaiman, 2018a).

Physics knowledge, skills and attitudes are developed effectively through effective teaching and learning using practical work because science is taught excellently through practices (Millar, & Abrahams, 2009). Practical work has been regarded as a learning activity in which the students are actively engaged in manipulation and observation of real objects and materials (Millar, (2004). According to Lunetta, Hofstein, and Clough, (2007, p. 394), Practical work is among teaching and learning approaches that advance interaction between learners and materials. This support learners to highly visualize and familiarize themselves with the natural world. The use of practical work is an important approach in teaching and learning physics due to its potential to promote the acquisition of practical skills, engage, arouse interest and attitudes of learners towards sciences learning (Score, 2008). Practical activity leads to the development of conceptual knowledge and the acquisition of procedural abilities (Antwi et al., 2021). Practical activity is important in the development of scientific knowledge because it links thinking to actions performed during experimental activities (Millar, 2004). Practical practise also assists students in developing connections between observations and concepts (Abrahams & Millar, 2008). According to Omeodu (2018), practical work promotes learners' knowledge acquisition, develops skills and competences necessary to satisfy the nation's scientific and technical demands, makes scientific phenomena more tangible, and improves social interaction during practices. As a result, practical activity plays a vital role in enhancing physics teaching and learning. Its successful implementation is hampered by a variety of restrictions, including a shortage of funding for acquiring and maintaining practical equipment and a lack of motivation to pique instructors' interest and commitment to organising practical activities (Niyitanga et al., 2021).

In terms of their pleasure and understanding of science, students perceive practical activity as both affective and effective. In a survey of over 1,400 students in England (of various ages), 71% chose "doing an experiment in class" as one of the three methods of teaching and learning science they found "most enjoyable," and 38% claimed it as one of the three methods of teaching and learning science they found "most useful and effective." In both occasions, this put it third in the rankings. Despite these findings, a number of scientific educators (Abrahams & Millar, 2008; Hodson, 1991; Osborne, 1993; Wellington, 1998) have questioned its efficacy.

According to Alkan (2016), practical activity helps learners build problem-solving abilities and conceptual knowledge. Students learn better in activity-based courses where they may control equipment and apparatus to obtain knowledge of the subject matter. Millar (2008) proposed that practical work be understood as a tool for deliberately and critically bringing together materials and equipment to persuade the learner about the reality and validity of the scientific worldview. Critical thinking abilities may be gained by practical work in science, particularly physics, if practised correctly beginning in early secondary school. According to Olubu (2005), ineffective scientific instruction is hampered by a lack of proper gear and instructors' incapacity to adapt. Many physics professors prefer to teach the topic theoretically rather than practically, resulting in pupils having unfavourable impressions and attitudes towards the subject and hence hating it. According to Masingila and Gathumbi (2012), many scientific instructors in impoverished countries are primarily educated on theoretical content elements, which explains why they struggle with Physics practical lectures. According to the researchers' personal experiences with teaching Physics at the senior high school level in Ghana, many students in senior high schools do practical work in Physics only at the end of their studies, that is, in their final year. As a result, these pupils frequently lack the necessary fundamental experimental procedures, which can only be gained by consistent practical work from the start of the senior high school course to the finish. In light of this context, the researchers set out to determine the impact of practical work on students' academic progress, acquisition of scientific process skills, and attitudes towards the study of specific topics in electricity.

The value of practical work in science is generally acknowledged, and it is recognised that high-quality practical work fosters student engagement and enthusiasm while also developing a variety of skills, science knowledge, and academic accomplishment. However, it appears that senior high school Physics teachers have not been able to undertake appropriate practical work with their pupils in most of the Physics concepts since it is time-consuming. There is also the issue of a lack of equipment and facilities, as well as instructor incompetence and insufficient time allocation, which forces these professors to use the lecture technique rather than practical work.

2.5. Concept of Practical Work.

According to Woodley (2009), successful practical work may help students gain key abilities in comprehending the process of scientific enquiry as well as their conceptual comprehension. Scanlon, Morris, Di Paolo, and Cooper (2002) agree that practical work has a clear impact on students' academic progress. Although difficult, the influence of practical tasks bridges the gap between hands-on and mind-on activities (Woodley, 2009). According to Abrahams and Millar (2008), the minds-on components of practical work should be enhanced in order to improve students' grasp of scientific principles. Students are able to engage with materials and inspect and observe phenomena in a laboratory during practical work. According to Woodley (2009), competent practical work can assist students learn crucial skills in understanding the scientific inquiry process as well as conceptual comprehension. Practical labour has a strong influence on students' academic success, according to Scanlon, Morris, Di Paolo, and Cooper (2002). Despite their difficulty, practical tasks bridge the gap between hands-on and mind-on activities (Woodley, 2009). Abrahams and Millar (2008) argue that the minds-on components of practical work should be improved in order to increase students' understanding of scientific ideas. During practical work, students can interact with materials and inspect and observe phenomena in a laboratory.

2.6. Attitude of Students towards Practical-based Teaching and Learning of Science.

Students' attitudes towards certain subjects influence their learning and performance in the discipline. According to Partin and Haney (2012), innate attitudes such as interests, beliefs, confidence, and self-efficacy can influence how students approach learning, including problem-solving skills, study habits, and critical thinking with that discipline. Science practical activities have been recognised for their role in growing students' enthusiasm in science and competence to handle equipment, as well as guaranteeing favourable student attitudes towards science. Sneddon, Slaughter, and Reid (2009) discovered that laboratory work increased the practical skills and theoretical understanding of university students in Scotland. According to Kim and Chin (2011), practical work is an important instrument for strengthening students' scientific knowledge and habits of mind. Toplis and Allen (2012) also said that practical activity is essential in ensuring that learners' in-depth grasp of subject is increased throughout the early years of secondary school scientific instruction. According to Glasman and Albarracin (2006), one of the most essential reasons for developing students' favorable attitudes towards science is that attitude predicts behavior (Antwi et al., 2021).

However, physics education has been in decline. In many African nations, enrollment in physics courses at all levels is minimal. Reasons for this include insufficient lower-level preparation, a weak mathematical background, a lack of work opportunities outside of the teaching profession, insufficient teacher qualification, and a lack of pedagogical topic understanding (Semela, 2010). Physics is perceived as difficult, abstract, and theoretical by many students (A. M. Musasia et al., 2012). The subject is thought to be devoid of practical applicability. Many students find the material tedious and uninteresting (Hirschfeld, 2012). Interest in high school physics is dwindling, as is learning motivation, and exam outcomes are deteriorating. In many educational settings, compared to language and mathematics, the two essential courses, insufficient time is provided for discipline (Tesfaye & White, 2012; UNESCO, 2010). The emphasis of instruction is on memorising of basic topics and their replication in tests (Sadiq, 2003).

Expertise in reading various scales is gained. The observations and outcomes are utilised to get a better knowledge of physics principles. Science process skills, which are required in the workplace, are deliberately cultivated (Manjit et al, 2003). Firsthand knowledge is produced. Abstract concepts may be made concrete. Ideas that are naive, infantile, or scientifically unsophisticated can be questioned (Osborne, 2002). It is possible to obtain tacit knowledge about scientific phenomena (Collins, 2001). Practical activity fosters motivation and interest in physics education. Students learn better in activity-based courses where they may control equipment and apparatus to obtain knowledge of the subject matter. According to Millar (1998), practical activity should be understood as the process via which materials and equipment are carefully and critically assembled to persuade the physics learner about the authenticity and validity of the scientific world view. Critical thinking abilities may be gained via practical work in physics if practised correctly beginning in early secondary school. Practical work places students at the centre of learning, allowing them to participate in physics rather than being lectured about it. The desire and excitement to learn more about what the topic has to offer is created in this way.

3.0. CHAPTER THREE: RESEARCH METHODOLOGY.

3.1. Research Design.

This study employed a quasi-experimental approach, which is characterised as the absence of random assignment, allowing investigations to be more practical (White & Sabarwal, 2014). The study used a quasi-experimental approach with a pre-test and post-test nonequivalent group. Following the pre-test, the experimental group was taught physics through rigorous practical exercises, whereas the control group was taught using traditional techniques. Because the manner of allocating participants required nonequivalent full class groupings, this approach was adopted. The class sizes were not comparable.

3.2. Sample Size.

The respondents in the control and experimental groups were chosen using a stratified sample approach based on their skill levels (Gambari, Obielodan, & Kawu, 2017). As a result, 46 students were allocated to the experimental group and 46 students were assigned to the control group. Table 3.1 depicted the distribution of students in the experimental and control groups.

Table. 3.1: Students participating in the research.

Group	Number of Students Per Group		Total
	Experimental	Control	
Form 4	30	21	51
Form 5	8	12	20
Form 6	8	13	21
Total	46	46	92

Out of the 92 respondents, 46 formed the experimental group and 46 formed the control group.

3.3. Instruments.

The pre-achievement exam was used to assess both groups' academic performance prior to treatment implementation. After that, the experimental group was instructed through extensive practical exercises. Following each practical, the teacher led a class interaction and discussion. The responders used data collection, manipulation, and analysis as an experimental technique before drafting an experimental report. The control group was taught using traditional techniques. This mostly consisted of academic lectures with little practical application. In the control group, instructor demonstrations were largely used to illustrate components of the practical. At the conclusion of the study, the Performance Test on the Chosen Topics (PTCT) was administered. The final score was calculated by adding the results of particular exams created from three themes chosen at random. Turning Effect of a Force, Reflection at Curved Surfaces, and Magnetic Effect of an Electric Current are among the subjects covered. The pre-achievement and post-achievement tests were also confirmed by two specialists with more than five (5) years of teaching experience in physics. To avoid identification, all of the questions in the post-achievement exam were reshuffled and interchanged with those in the pre-achievement test (Gambari et al., 2017). The pre-achievement exam was trialed on fifty (50) Form 4, 5, and 6 students from various schools to check the applicability and clarity of the questions for reliability. Using the formula, the Cronbach's Alpha (α) Coefficient was calculated to be 0.87:

$A = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K}\sigma_{Yi}^2}{\sigma_x^2}\right)$, where σ_x^2 is the variance of the observed total test scores, and σ_{Yi}^2 the variance of the component *i* for the current samples of the students.

Cronbach's alpha is a measure used to assess the reliability, or the internal consistency, of a set of scale or test items.

Mann-Whitney U Test was used to determine the effects of practical work on students' academic performances was then used to determine the effects of practical work on students understanding towards learning physics.

3.4. Data collection and analysis.

Students in the control group were taught using a standard teaching style in which they merely listened to the teacher's instructions and took notes. Meanwhile, pupils in the experimental group were taught through actual labor. Six (5) experiments on the theme of "Forces and Motion" were carried out by form 4s. The list of experiments carried out in this study was shown in Table 3.2.

Table. 3.2: Experiment details.

No.	Experiment details for Form 4
1.	Investigate how the extension of spring depends on the stretching force
2.	Investigate the relationship between period of oscillation and the mass of the load of a spring-mass system.
3.	Investigate how the volume of a given amount of water changes with temperature
4.	Investigate the relationship between the resistance R, and length L of a wire
5.	Determining specific latent heat of fusion using electrical method
	Experiment details for Form 5 & 6
1.	Investigate the variation of the terminal velocity of the ball with the radius
2.	Investigate the contraction of a spring when a current flows through it
3.	Investigate the relationship between the amplitude of a sound wave reflected from a surface and frequency of the incident wave.
4.	Investigate the young modulus of wood
5.	Investigate the time taken for a fuse to blow up once current has risen above a certain predetermined value.

4.0. CHAPTER FOUR: RESULTS AND DISCUSSION.

Because the data gathered were not normally distributed and there were a limited number of students in each group, a non-parametric test, the Mann-Whitney U Test, was used to analyse the data (Kishore & Jaswal, 2022). As a result, rather than the mean value, this study focuses on rankings, medians, or frequencies (Oti et al., 2021). Academic performance of students in both groups prior to therapy revealed no significant change (U = 899.500, Z = -0.913, p = 0.361, p > 0.05 is not significant). The data analysis found that pupils in both groups were similar in ability. Table 3 shows that the experimental group's mean rank was marginally higher than the control group's. The experimental group's mean rank was 50.81, whereas the control group's was 40.19. As a result of the Mann-Whitney U test, there was no significant difference in mean rank between the experimental and control groups for the pre-achievement exam.

Table 4.1: Mean Rank of Students' Academic Performances for Both Groups Before the Treatment.

Variable	Group	N	Mean Rank	Sum of ranks	U	Z	Wilcoxon W	Asymp. Sig. (2-tailed)
pre-achievement test	Experimental	45	50.81	2286.50	899.500	-0.913	1934.500	0.361
	Control	45	40.19	1808.50				

Table 4.2: Descriptive Statistics.

Group	N	Mean	Std. Deviation	Minimum	Maximum
Post-test	90	66.44	11.505	43	90
Pre-test	90	54.40	9.954	43	83
Total	90	1.50	.503	1	2

4.1. Students' post-achievement test between control and experimental group.

The purpose of the data analysis in this section is to determine the academic performance in physics of the control and experimental groups following treatment. The mean rank of students' academic results in both groups after therapy was shown in Table 4.1. According to the Mann-Whitney U test findings, there was a significant difference between the experimental and control groups' mean rank for the post-achievement exam (U = 380.00, Z = -2.120, p = 0.034, p 0.05 is significant). The data analysis demonstrated that following the therapy, students in the experimental group fared better than students in the control group. The Mann-Whitney U test findings were shown in Table 4.3 and Figure 4.4, where the mean rank for students in the experimental group was greater than the control group. The experimental group's mean rank was 48.01, whereas the control group's was 42.99. As a result, the null hypothesis (H_1), that there is no significant difference between the control and experimental groups in students' post-achievement tests, is rejected. These findings are consistent with those published by (Belay et al., 2018).

Table 4.3: Mean Rank of Students' Academic Performances for Both Groups after the Treatment

Variable	Group	N	Mean Rank	Sum of ranks	U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
Post-test achievements	Experimental	45	48.01	2160.50	773.500	1808.500	-1.930	0.034
	Control	45	42.99	1934.50				

Table 4.4. displayed the mean gain scores of students in both groups between the pre-achievement test and the post-achievement test, and it was compared to illustrate improvement in academic performance after treatment. The post-achievement mean scores improved in both groups. However, the experimental group's mean gain score was larger than the control groups, with the experimental group scoring 12.04 and the control group scoring 5.83. Thus, once again, the experimental group outperformed the control group.

Table 4.4: Mean Gain Scores of Students between Pre-achievement test and post-achievement test for Both Groups.

Group	Pre-achievement test Mean	Post-achievement test Mean	Mean Gain Scores
Experimental Group	54.40	66.44	12.04
Control Group	52.40	58.23	5.83

Students' academic performance was affected and enhanced by practical work, where students may recollect what they see and touch rather than what they hear (Lee & Sulaiman, 2018a). It is recommended that weaker students be taught via practical work since they do better than other students who are taught using the lecture technique (Maloneythomas et al., 2012). Furthermore, research have revealed that schools that engage in practical work have a larger impact on their students' academic progress in scientific courses (Lee & Sulaiman, 2018b). As we all know, practical labour may provide good outcomes in science (Abrahams & Reiss, 2012). Furthermore, students who performed well in the practical work might perform well in the final physics test (Harrison, 2016; Sharpe & Abrahams, 2019). The reason for this is that practical work helps students recall the apparatus and equipment that have been utilised, and it gradually develops students' manipulative abilities (Fernandez, 2017). It allows pupils to have a better comprehension of the topic matter (Sharpe & Abrahams, 2019).

A. M. Musasia et al. (2012), Sharpe & Abrahams (2019), and Antwi et al. (2020) found that practical work improved both male and female performances in physics sciences equally and did not make a distinction based on gender. However, in this study, we did not examine the impact of practical work on performances in physics sciences among female and male students. The application of practical work might undoubtedly enhance the academic performance of both men and women in the physical sciences (Thair & Treagust, 1999). This is so that all learners, regardless of gender, may perform better thanks to cooperative learning in practical work (Valente et al., 2022). Furthermore, pupils' mastery of a science topic is unaffected by differences in gender (Okam & Zakari, 2017). However, research conducted by (Lee & Sulaiman, 2018b) found that male students did better than female students because they were more eager to understand how things worked and had a stronger interest in science class than female students (Dare & Roehrig, 2016). Furthermore, male students are thought to grasp physics concepts better than female pupils. (Covitt et al., 2023; P. A. M. Musasia et al., 2016).

The attitude of students towards studying physics and other science disciplines through practicals influences how effective this teaching technique may be (Havlek, 2015; Ojo et al., 2020). According to the findings of (Toplis, 2012), students value practical work in school science lessons for three reasons: for interest and activity, including social and personal features such as participation and autonomy; as an alternative to other forms of science teaching involving a transmission pedagogy; and as a method of learning, including memorizing and recall.

Physics Laboratory Equipment (PLE) for the teaching and learning of physics in senior secondary schools should be provided in sufficient quantities for it to be effective. According to the findings of (Olufunke, 2012), a scientific laboratory with proper equipment is a crucial determinant in influencing the quality of output from senior secondary school. Physics.

The importance of practical’s in learning cannot be overstated. With the presence of technology influencing modern education, many studies have published the use of e-labs that mimic physical labs to help students understand science subjects like physics better through the use of laboratory set ups (Bestiantono et al., 2020; Dwikoranto et al., 2020; Wästberg et al., 2019).

5.0. Conclusion.

The study revealed that practical activity aided students' academic success in certain subjects such as electricity. This is demonstrated by the fact that students' average academic accomplishment after the introduction of frequent practical work was greater than students' average academic achievement before to the introduction of frequent practical work, as well as higher than the control group. During the study's intervention techniques, the students' degree of acquisition of the required scientific process abilities for science practical work was considerably improved.

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