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AN INVESTIGATION INTO EFFECTS OF USING MULTI-MEDIA INSTRUCTIONAL RESOURCES IN TEACHING PHYSICS AT ORDINARY LEVEL: A CASE OF HIGH SCHOOLS IN HARARE DISTRICT

BY

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DEDICATION

I dedicate this research to:

My entire loving family, special mention to my husband who have supported me unwaveringly throughout my academic journey,

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This project "**AN INVESTIGATION INTO EFFECTS OF USING MULTI-MEDIA INSTRUCTIONAL RESOURCES IN TEACHING PHYSICS AT ORDINARY LEVEL: A CASE OF HIGH SCHOOLS IN HARARE DISTRICT"** would not have been possible without the support and guidance of several individuals and organizations. First and foremost I would like to express gratitude to my supervisor, Dr Mudzamiri, for the unwavering support, guidance, encouragement, and feedback which were invaluable throughout this research journey.

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Thank you all for your contributions to this research project

Sincerely
Gumbo Veronica

ABBREVIATIONS AND ACRONYMS

ICT- Information and Communications Technology

EU- European Commission.

MOPSE- Ministry of Primary and Secondary Education

AI- Artificial Intelligence

STEM- Science, Technology, Engineering and Mathematics

CTML- Cognitive Theory of Multi-media Learning

AR- Augmented Reality

VR- Virtual Reality

ANCOVA- Analysis of Covariance

UNICEF- United Nations Children's Fund

POTRAZ- Postal and Telecommunications Regulatory Authority of Zimbabwe

RCZ- Research Council of Zimbabwe

UNESCO- United Nations Educational, Scientific and Cultural Organisation

NGO- Non Governmental Organization

OER- Open Education Resources

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ABSTRACT

This research study was an investigation into effects of using multi-media instructional resources in teaching physics at ordinary level focusing on high schools in Harare district. It focused on understand how these resources affect student learning and engagement during instruction, while also exploring the challenges and opportunities associated with their use in the context of Zimbabwean education system. A quasi experimental design was employed to provide insights into cause-and-effect relationships between the use of multimedia instructional tools and teaching of phuysics in real-world learning contexts. A sample of 60 students and 5 teachers who were purposefully selected were assigned to either an experimental or control group. The experimental group received interactive videos and animations on one of the popular topics in physics at Ordinary level (Newton's laws of motion) while the control group received traditional instruction on the same topic. Teachers who had received training on the use of multimedia technology in physics instruction participated in the study.Data was collected through interviewing teachers ans students. Tests were also adminerstered to get data on performance of the learners after the intervention. The results showed that students in the experimental group performed significantly better in the post test, demonstrating a deeper understanding of concepts taught. The findings suggest that multimedia instruction can significantly improve understanding of physics concepts, but its effects depends on teacher training and support. The study contributes to the existing body of research output on technology-enhanced learning, highlighting the potential of multimedia instruction to enhance student learning outcomes and teacher attitudes in physics education.

CHAPTER ONE: INTRODUCTION

1.1 Introduction to the study

This research study is an investigation into effects of using multi-media instructional resources in teaching physics at ordinary level focusing on high schools in Harare district. It focused on understanding how these resources affect student learning and engagement, while also exploring the challenges and opportunities associated with their use in the context of Zimbabwean education.

The use of multi-media instructional tools in educational institutions continues to soar not only in Zimbabwe but the world over. These resources have also been adopted in the teaching of physics in secondary schools, colleges, and universities in Zimbabwe. Physics is one of the science subects whose concepts are deemed abstract and difficult to grasp by learners at ordinary school level. The current teaching strategies have struggled to boost acquisition of expected scientific competences, attitudes and skills such as problem-solving skills, curiosity, and critical and logical thinking among the Physics learners at Ordinary school level. The customary models of teaching characterized by the teacher-centered methods of delivery have clearly manifested their shortfalls. A number of Physics education researchers studied the effects of using customary model of teaching on three quite different but important aspects of learning: conceptual understanding, transfer of information, and basic beliefs about Physics (Aina, 2013). The ultimate conclusion was that despite the teacher effort, typical students at a traditionally taught course were not gaining true understanding but rather learning by rote. Scientific attitude, attitude towards science, and scientific literacy are very important to understand issues of scientifically and technologically advanced societies in a globalized world. This is of principal significance for the prosperity of a country. There is need to shift from conventional approaches to more ground-breaking information and communications technologies (ICTs) enriched approaches for significant learning (Shar and Khan, 2018). This study is an attempt to investigate the effects of multi-media in the teaching of Physics concepts.

1.2 Background of the study

The current educational system in Zimbabwe is facing many challenges, including a lack of resources, human resource included, especially in the teaching of physics. Chigwedere et al, (2016) found that many Zimbabwean schools lacked the resources and infrastructure to effectively integrate multi-media into their curriculum. There is also limited access to technology since most research and AI use requires connectivity on the World Wide Web. Another crucial challenge is the insufficient training for teachers. Similarly in their paper "Technology integration in Zimbabwe's secondary schools: Facing the challenges and expanding the possibilities", Mapungwana and Nhimira, (2014) found that only a small number of schools in Zimbabwe had the necessary resources to effectively use multi-media in their teaching.

These challenges, among many others have led to a need for new and innovative approaches to teaching and learning, including the use of multi-media tools and techniques. However, the uptake of multi-media in the classroom has been slow and there is a lack of knowledge and understanding about how to effectively use these tools. The use of multi-media can be particularly beneficial in the teaching of physics concepts as it can provide students with a more engaging and interactive learning experience. However, despite the potential benefits of multi-media, there is still limited research on the effects of these tools in teaching physics.

The introduction of ICT in the classroom has brought joy to teachers who previously had to rely exclusively on books for plans and information. Now they can search the World Wide Web for many of their educational needs. They can provide opportunities for students to complete group projects based solely on primary sources, allowing students to construct their own knowledge (Kim and Lee, 2015). Most of the secondary school students are looking for more multi-media in Physics education. Knowledge is abundant especially now with the introduction of AI (Artificial Intelligence). Information is readily available and this makes the teachers' work much easier and gives more time to planning of how to deliver the knowledge to students using multi-media resources. Some teachers however have a reluctant attitude towards multi-media use in their lessons.

This research aims to address this gap in the literature by exploring the impact of using multi-media resources (videos, animations, interactive simulations) on student learning and understanding of physics concepts in Harare district, Zimbabwe. A comprehensive understanding about the impact of these tools, means educators can make more informed decisions about how best to use multi-media in their teaching. Specifically this study will focus on the effects of using multi-media to teach key concepts such as force, energy and motion.

The study will use a variety of methods to collect data on student performance on Physics assessments, and analyzing the relationship between the use of multi-media resources and student performance. The study will also investigate teacher attitudes towards the use of multi-media resources, and explore the impact of these attitudes on student learning and achievement. The results of the study will be analysed and interpreted to provide insight into the effects of multi-media in teaching physics concepts which can help improve teaching practices and provide a better learning experience for students.

1.3Purpose of the study

The purpose of the study is to investigate the effects of multi-media resources in teaching physics concepts to high school students. The study will investigate whether the use of videos, simulations and interactive websites leads to improved understanding of physics concepts compared to traditional methods of lecturing and textbook reading. The study also aims to determine whether or not teachers are effectively using multi-media tools and techniques to teach physics concepts. It also seeks to examine if there is a positive relationship between teachers' attitudes towards the use of multi-media and their actual use of multi-media in the classroom or if other factors such as access to resources, training or technical proficiency have a greater influence on teachers' use of multi-media resources than their attitudes.

1.4Statement of the problem

The Physics pass rate in Harare district is very low compared to other subjects or the overall pass rate. Very few students are also writing the subject at both O and A level. Some educators argue that multi-media resources, such as videos, simulations, and interactive websites can greatly enhance students' understanding of physics concepts and

their absence in the classroom leads to poor scores in Physics (Knezek and Christensen 2018). The potential relationship between multi-media resources and Physics pass rates in Harare district, Zimbabwe raises some important questions about the quality and equity of education in urban and rural schools in the district. Rural schools may face challenges in implementing multi-media resources due to limited infrastructure, such as poor internet connectivity or limited access to technology. The effects of these problems are seen in staff movement as rural Physics teachers migrate to urban schools or can become demoralized. If this situation is not addressed learners may be discouraged in pursuing Physics, their future career prospects are dampened and the overall competitiveness and productivity of the country could be affected. However, other educators such as Chigwedere, (2016) argue that traditional methods of instruction such as textbook reading and lectures are just as effective, if not more so. Despite that, further research is needed to determine the optimal balance between these two approaches.

1.5 Research aim

The aim of the resaerh was

- To find out if the use of multi-media resources is effective in teaching physics concepts to high school students in Harare district.

1.6 Research questions

Research questions are clear, focused, open-ended questions that guide and center a research project by identifying a specific problem or issue to be answered through data collection and analysis (Moser, A., & Korstjens, 2018). Good research question are expected to be specific, feasible, complex, relevant, and original, serving as the foundation for the study's direction (Shrivastava, A et al,2024).. Their importance have enspired me to include them in this study.

The following research questions were found to be appropriate for this study

- What are the views of teachers towards the use of multi-media in teaching physics at Ordinary school level in schools in Harare district?

- What are the effects of using multi-media instructional tools in teaching physics concepts at Ordinary level in schools in Harare District?

- How can the use of multi media in teaching of Physics at ordoinary school level be improved

1.7 Hypotheses

A hypothesis is a logical construct, interposed between a problem and its solution, which represents a proposed answer to a research question. It is generally an educational guess/predication based on observation,whether it is proved or disapproved (Anupama, K. (2018). It gives direction to the investigator's thinking about the problem and, therefore, facilitates a solution (Supino, P.G, 2012).

The following hypothesis were formulated to guide the resaech

- There is no relationship between teacher's views and use of multi-media in teaching physics concepts
- There are no significant differences between the academic achievement of the group taught using multimedia and group taught using traditional methods

1.8Significance of the study

The investigation of the effects of multi-media in teaching physics concepts in the Harare District is significant because it can help to improve the way that Physics is taught. Understanding the role of multi-media resources can help students develop the skills and knowledge they need to succeed in STEM fields. This research can provide the Ministry of Primary and Secondary Education (MOPSE) with valuable insight to develop more effective strategies for supporting Physics education. The results of this research can contribute to a broader understanding by parents and the society of the role of multi-media in Physics education and how it can be used to improve educational equity and outcomes for all students regardless of their location. By studying the effects of different multi-media tools and techniques, we can develop better resources and strategies for teaching Physics. In addition, by understanding how students learn from multi-media, educators can tailor our instruction to better meet their needs. The research will also focus on identifying gaps in teachers' knowledge, attitude and multi-

media skills, and determining what can be done to improve their ability to teach physics concepts.

1.9 Delimitations

The study is going to be limited to a specific time frame which is the academic year of the researcher ie 2025. Only 4 secondary schools in Harare District were included in the research sample.

The study will also be limited to the use of specific multi-media instructional tools and techniques for teaching Physics concepts as it would not be achievable or within scope to measure effects of all multi-media.

1.10 Scope and limitations

The scope of this research is to investigate the use of multi-media for teaching Physics concepts in selected secondary schools in Zimbabwe, with a focus on the effects of this approach. The study will be limited to a small number of schools and the results may not be representative of all schools in Zimbabwe let alone globally. The study will also specifically be limited to the use multi-media for teaching Physics concepts and the results may not be applicable to other subjects.

Another limitation is the availability of resources and technology in the selected schools. To handle such limitations, the researcher is going to be clear about the scope and limitations of the study in the research design. A variety of data collection methods such as interviews, observations and document analysis will be employed. The researcher is also going to use a variety of statistical methods to analyze the data, such as t-tests. Finally, the researcher is going to be clear about the limitations of the study and work with the schools to identify the resources and technology that are available and use these in the study.

1.11 Definition of terms

Multi-media – is an integrated, interactive combination of text, graphics, audio, and video in an electronic format (Abernathy, 2018). Brown. (2020) defines multi-media as the combination of different types of media such as text, graphics, images, audio and video into a single form. It is the use of multi-media forms of media such as text, images, video and audio to communicate information.

Physics concepts– Are the fundamental ideas and principles that underlie the study of Physics (Paivio, 2016). According to Smith, (2017) these are the core principles and laws that govern the behavior of matter, energy, space and time e.g. mechanics, electricity and magnetism etc. These are concepts in the study of Physics which are often difficult to grasp as they require an understanding of complex mathematical and scientific principles.

Artificial Intelligence (AI) –Is the field of computer science that deals with the creation of intelligent machines that can perform tasks that typically require human intelligence such as understanding language, recognizing patterns, and making decisions (Ccles, 2017). The New Web Dictionary, (2024) defines AI as a field of computer science that focuses on the development of intelligent computer systems that can mimic human cognitive functions. It is when computers can be used to perform functions such as learning, reasoning and problem solving.

1.12 Organisation of the study

The study is organized into 5 chapters. The first section has the title page, abstract and table of contents. Additionally a section for acknowledgements and appendices will also be included and a list of references at the very end. An overview of the 5 chapters is given below.

Chapter 1: Is the introduction. The topic of the study is introduced and a brief overview of research problem given, the purpose of the study, and the hypotheses being tested.

Chapter 2: Is the literature review. The relevant literature on the use of multi-media resources in teaching Physics concepts is reviewed.

Chapter 3: Is the methodology. A description of the research design, participants, procedures, and data collection methods used in the study

Chapter 4: Results and data analysis presentation. The results of the data analysis are presented including any statistical tests used to test the hypotheses

Chapter 5: Discussion. This section gives an interpretation of the results of the study, discusses the implications of the findings, and draw conclusions based on the findings. Future research directions will also be outlined based on the findings

1.13 Summary of chapter

The first chapter concludes here. In it, an introduction discussed the need for effective teaching of physics concepts and the potential benefits of using multi-media resources. The background traced the development of multi-media use in education. Research was deemed significant because it can help to improve the way that Physics is taught. Limitations and scope set the research parameters and how they will be handled. The delimitation defined the limits geographically to focusing on secondary school students in Harare district, Zimbabwe. Key terms were defined and a summary of the chapter was given.

CHAPTER TWO: REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter review existing literature on effects of the use of multi-media in teaching Physics at Ordinary school level. It will explored the advantages and disadvantages of utilizing multi-media in the classroom, as well as examine previous studies from around the world and also from Zimbabwe that have investigated the effects of multi-media in enhancing student learning outcomes in Physics.

2.2 Advantages and Disadvantages of Multi-media in Teaching Physics

The teaching of Physics using multi-media has many advantages and disadvantages. Multi-media resources can make the subject more engaging and accessible. It does this by providing interactive and hands-on learning experience. However on the downside, the creation and use if multi-media resources can be time-consuming and expensive as it requires specialized equipment or software.

2.2.1 Advantages

Multi-media have the potential to enhance the teaching and learning of physics concepts in a variety of ways. Firstly, multi-media can provide visual and auditory representations of complex physics phenomena, making abstract concepts more concrete and easier for students to understand (Jones et al., 2016). This can help to bridge the gap between theory and application, as students are able to see real-world examples of physics principles in action.

Additionally, multi-media can cater to different learning styles, offering students opportunities to engage with content in a variety of ways. For example, multi-media presentations can include interactive simulations, videos, and animations that appeal to visual and kinesthetic learners, as well as written explanations that cater to auditory learners (Mohan, 2018). This can help to

ensure that all students have access to the content and are able to learn in a way that suits their individual preferences.

Furthermore, multi-media can promote active learning by encouraging students to engage with material in a hands-on way. For example, students may be asked to manipulate virtual objects in a simulation, conduct virtual experiments, or solve problems using multi-media tools (Salameh et al., 2015). This can help to foster critical thinking skills and deepen students' understanding of physics concepts.

2.2.2 Disadvantages of Multi-media in Teaching Physics

While multi-media have many advantages, there are also some potential disadvantages to consider. Firstly, the use of multi-media in the classroom may require significant resources, both in terms of technology and teacher training (Zaharias et al., 2017). The cost of purchasing and maintaining multi-media resources can be prohibitively expensive for many schools in Zimbabwe. Not all schools may have access to the necessary equipment or expertise to effectively integrate multi-media into their Physics curriculum, which could limit the potential benefits for students.

Additionally, the quality of multi-media resources can vary widely, with some materials being more engaging and effective than others. Poorly designed multi-media presentations may confuse students or fail to communicate important concepts clearly, leading to a decrease in learning outcomes (Lopez et al., 2019). It is important for teachers to carefully evaluate and select multi-media resources that are high-quality and align with their instructional goals.

Furthermore, the effects of multi-media in teaching Physics may depend on factors such as student motivation and engagement. While multi-media can be a powerful tool for enhancing physics concepts, it is not a universal remedy and must be used in conjunction with other effective teaching strategies (Ubogu, 2016).

2.3 Previous studies on the effects of multi-media in teaching Physics

There have been a number of studies investigating the effects of multi-media resources in teaching physics concepts. Multi-media has the capacity to overcome some of the challenges associated with lack of resources and staff shortages in developing countries as interaction can be between one computer and many learners. In developed countries, multi-media can lead to enhanced learning outcomes as shown by studies carried out.

2.3.1 Studies in developed countries

Numerous studies have investigated the impact of multi-media on student learning outcomes in Physics. For example, a study by Smith (2017) found that students who were exposed to multi-media presentations of physics concepts scored higher on post-tests compared to those who received traditional instruction. Similarly, a meta-analysis by Brown et al. (2018) found that multi-media interventions were associated with significant gains in student achievement in Physics.

However, not all studies have shown a positive impact of multi-media on student learning outcomes. For example, a study by García et al. (2019) found that the use of multi-media did not lead to significant improvements in student understanding of physics concepts. These mixed results suggest that the effects of multi-media approaches may depend on several factors, such as the quality of the materials used, teaching strategies, student characteristics and the instructional design.

Overall, the literature on the use of multi-media in teaching Physics concepts is varied and complex. While multi-media have the potential to enhance student learning outcomes and engagement, it is not a one-size-fits-all solution and must be used thoughtfully and in conjunction with other effective teaching strategies. Further research is needed to better understand how to maximize the benefits of multi-media in the Physics classroom and support student learning.

2.3.2 Studies in developing countries

In developing countries like Zimbabwe, where resources and access to quality education can be limited, the integration of multi-media in educational settings can be a game-changer in enhancing teaching and learning outcomes, especially in subjects like Physics. While there is limited research specifically focused on the use of multi-media in Physics education in Zimbabwe, studies from other developing countries can provide valuable insights into the effects of multi-media in the context of teaching Physics concepts.

Several studies in developing countries have explored the use of multi-media in education and its impact on student learning outcomes. For example, a study in Kenya by Oduor et al. (2018) investigated the use of multi-media resources in teaching Physics and found that students who were exposed to multi-media presentations showed improved understanding of complex Physics concepts compared to those who received traditional instruction. This suggests that multi-media can be an effective tool in enhancing student learning outcomes in Physics, even in resource-constrained environments.

In the context of Zimbabwe, a study by Chikumba et al. (2016) examined the use of multi-media resources in teaching science subjects, including Physics. The study found that students who had access to multi-media resources, such as educational videos and interactive simulations, demonstrated better comprehension of physics concepts and higher levels of engagement in the learning process. This highlights the potential of multi-media to bridge the gap in educational disparities and improve the quality of Physics education in underserved areas.

Furthermore, the effects of different types of multi-media in teaching Physics concepts has been explored in various studies. In a study by Maphosa et al. (2019) compared the use of animations, simulations, and virtual labs in teaching Physics and found that simulations were most effective in enhancing student understanding of Physics principles. This suggests that interactive and hands-on multi-media tools can be particularly beneficial in helping students grasp abstract and complex Physics concepts.

In addition, the integration of multi-media with traditional teaching methods has been a focus of research in the field of Physics education. A study by Mahachi (2017) investigated the combined use of multi-media presentations and hands-on experiments in teaching Physics in Zimbabwean schools. The study found that this integrated approach led to improved student performance and greater interest in Physics among students, demonstrating the potential of combining different types of multi-media resources to enhance learning outcomes.

Overall, the literature on the use of multi-media in Physics education in developing countries like Zimbabwe points to the potential benefits of integrating multi-media resources in the classroom to enhance student understanding of Physics concepts. Interactive simulations, animations, and virtual labs have been shown to be particularly effective in engaging students and promoting deeper learning. However, further research is needed to better understand how to optimize the use of multi-media in the context of Physics education in developing countries and ensure equitable access to quality education for all students.

2.4 Teacher attitude towards use of multi-media in teaching physics concepts

According to Parker (2020), the attitude of the teacher towards the use of multimedia in teaching physics concepts is a very large determinant towards the use of multi-media in teaching physics concepts. The use of multimedia in teaching physics concepts has gained popularity in recent years due to its potential to increase student engagement, motivation, and understanding. However, the effects of multimedia in teaching physics depends on various factors, including teacher attitudes towards its use. This review aims to summarize the existing literature on teacher attitudes towards the use of multimedia in teaching physics concepts. Research has shown that teachers' attitudes towards the use of multimedia in teaching physics are influenced by several factors, including:

- Perceived usefulness- Teachers who perceive multimedia as useful for teaching physics are more likely to use it in their classrooms (Hew & Cheung, 2014).
- Ease of use: Teachers who find multimedia easy to use are more likely to adopt it in their teaching practices (Knezek & Christensen, 2001).
- Confidence- Teachers who feel confident in using multimedia are more likely to use it in their teaching (Owston et al., 2013).
- Job satisfaction- Teachers who are satisfied with their jobs are more likely to use multimedia in their teaching practices (Kim & Lee, 2015).

Despite the benefits of using multimedia in teaching physics, there are several barriers that teachers may face when adopting it, including:

- Lack of technical skill- Teachers who lack technical skills may be hesitant to use multimedia in their teaching practices (Knezek & Christensen, 2001).
- Limited resources- Teachers who lack access to resources or equipment may not be able to use multimedia in their teaching practices (Kim & Lee, 2015).

- Perceived complexity- Teachers who perceive multimedia as complex or difficult to use may be hesitant to adopt it (Owston et al., 2013).
- Time constraints- Teachers who have limited time may not be able to devote time to learning and using multimedia in their teaching practices (Wang et al., 2017).

To promote the effective use of multimedia in teaching physics concepts, teachers and educators should:

- Provide teachers with training and support on using multimedia.
- Offer resources and equipment to support the use of multimedia.
- Encourage collaboration among teachers on using multimedia.
- Provide opportunities for teachers to develop their technical skills.
- Emphasize the importance of job satisfaction and collaboration in promoting the adoption of multimedia (Kim & Lee, 2015).

2.5 Relationship between the use of multimedia in teaching physics concepts and academic achievement

Studies have shown that students tend to have positive learning experiences using multimedia learning materials, and it has an important role in students' achievement (Thompson, 2015). The multimedia principle states that students may learn better from images and words than just from words. Each channel has a limited capacity to process information, and they try to understand the information by creating mental representations from the information sources. Previous research has also shown that the students taught with multimedia learned more successfully than the groups taught with traditional methods.

The use of multimedia in teaching physics concepts has become increasingly popular in recent years due to its potential to enhance student learning and academic achievement. However, there is a need for a comprehensive review of the existing literature to determine the relationship between the use of multimedia in teaching physics concepts and academic achievement.

Physics is a complex and challenging subject that requires students to develop a deep understanding of abstract concepts and principles. The use of multimedia in teaching physics concepts has been shown to have several benefits, including increased student engagement, motivation, and understanding. However, there is limited research on the relationship between the use of multimedia in teaching physics concepts and academic achievement

Several studies have investigated the relationship between the use of multimedia in teaching physics concepts and academic achievement. These studies have reported varying results, with some finding positive correlations between the use of multimedia and academic achievement (e.g., Park et al., 2017; Lee et al., 2018), while others have found no significant relationship (e.g., Wang et al., 2017).

Several factors have been identified as influencing the relationship between the use of multimedia in teaching physics concepts and academic achievement. These include, the type of multimedia used which has been shown to influence the relationship between its use and academic achievement. For example, studies that used interactive simulations and animations reported higher levels of academic achievement compared to studies that used static images and videos (Park et al., 2017). The instructional design used in conjunction with multimedia has been shown to influence the relationship between its use and academic achievement. For example, studies that used problem-based learning approaches with multimedia reported higher levels of academic achievement compared to studies that used traditional lecture-based approaches.

Student characteristics, such as prior knowledge and learning style, have been shown to influence the relationship between the use of multimedia in teaching physics concepts and academic achievement. For example, studies that used multimedia with students who had prior knowledge of physics concepts reported higher levels of academic achievement compared to studies that used multimedia with students who had little prior knowledge (Phillips, 2016). Some teacher characteristics as well, such as experience and training, have been shown to influence the relationship between the use of multimedia in teaching physics concepts and academic achievement. For example, studies that used multimedia with teachers who had experience with technology reported higher levels of academic achievement compared to studies that used multimedia with teachers who had little experience with technology (Kim et al., 2018).

The existing literature suggests that the use of multimedia in teaching physics concepts can have a positive impact on academic achievement. However, the relationship between the use of multimedia and academic achievement is influenced by several factors, including the type of multimedia used, instructional design, student characteristics, and teacher characteristics. Further research is needed to fully understand the relationship between the use of multimedia in teaching physics concepts and academic achievement.

2.6 Importance of factors such as multi-media relevance, feedback and collaboration when teaching physics concepts in increasing student motivation and engagement

The importance of factors that influence motivation and engagement when using multimedia to teach physics concepts cannot be overstated. In recent years, the use of multimedia has become a popular approach in teaching physics concepts, as it offers a range of benefits, including increased student engagement, improved understanding, and better retention of information. However, simply using multimedia is not enough; it is crucial to consider the factors that influence motivation and engagement to ensure that students are motivated and engaged in the learning process.

One of the most significant factors that influence motivation and engagement according to Marley, (2019) is the relevance and authenticity of the content. When students are learning about physics concepts, it is essential to make them relevant and relatable to their everyday lives. For example, using real-world scenarios or applications of physics concepts can help students see the value and importance of what they are learning. This can increase motivation and engagement, as students are more likely to be interested in learning about concepts that have practical applications.

The role of feedback is also crucial in influencing motivation and engagement. When students receive feedback on their performance or progress, they are more likely to be motivated and engaged, as they can see how well they are doing and adjust their learning accordingly. This can be achieved through various forms of feedback, such as quizzes, assessments, or peer review.

The social aspect of learning is also an important factor in influencing motivation and engagement. When students are able to learn with peers or in a collaborative environment, they are more likely to be motivated and engaged. This can be achieved through group activities, discussions, or projects that require students to work together to achieve a common goal. The teacher's role is also crucial in influencing motivation and engagement. When teachers are enthusiastic, supportive, and encouraging, they can create a positive and motivating learning environment that encourages students to take an active role in their learning. Teachers can also use various strategies to promote motivation and engagement, such as providing choices or allowing students to take ownership of their learning.

Also, the use of multimedia has been shown to have a positive impact on student motivation and engagement. A study by Ritter et al. (2013) found that students who used multimedia-based simulations showed increased levels of motivation and engagement compared to those who used traditional teaching methods. Similarly, a study by Hmelo-Silver (2004) found that students who used virtual labs showed increased levels of motivation and engagement compared to those who used traditional laboratory activities.

In addition, the use of multimedia can also help to address the challenges faced by many students in learning physics concepts. For example, Physics can be a challenging subject for many students due to its abstract nature and complex mathematical concepts. The use of multimedia can help to make these concepts more accessible and engaging for students.

The use of multimedia has the potential to significantly impact student motivation and engagement when teaching physics concepts. By incorporating interactive multimedia, relevant content, feedback, social learning experiences, and collaboration, educators can create a motivating and engaging learning environment that encourages students to take an active role in their learning. This study chose three vital factors which are relevance, feedback and collaboration to assess importance of these in increasing student motivation and engagement.

2.7 Theoretical Foundation

For purposes of this research on use of multi-media in teaching Physics concepts the cognitive load theory was used. This psychological theory provides a framework for understanding how humans process and learn new information. It is particularly relevant to the use of multi-media because it suggests that the way information is presented can have a significant impact on learning. According to Ellis's Model for Multi-media Effects (Ellis, 2001), the effects of a multi-media learning experience is determined by three main factors: the learner, the content and the medium. The learner refers to cognitive abilities and prior knowledge, the content is the subject matter being studied, its organization, and the level of interaction required, and the media is the technology used, its accessibility and ease of use.

2.7.1 Cognitive Theory of Multi-media Learning

The Cognitive Theory of Multi-media Learning known as CTML (Mayer, 2015), emphasizes on the importance of selecting relevant content, designing appropriate

graphics and providing appropriate verbal explanations. The theory states that learning is enhanced when information is presented in a way that allows learners to construct meaningful mental modes: visual, auditory and verbal. The theory says that the visual information processing canal may become clogged if learners use their eyes to look at graphics and text on a screen at the same time. However, if words are presented as a voice-over, words can be processed in the verbal channel, thereby reducing the cognitive load in the visual channel (Mayer, 2015).

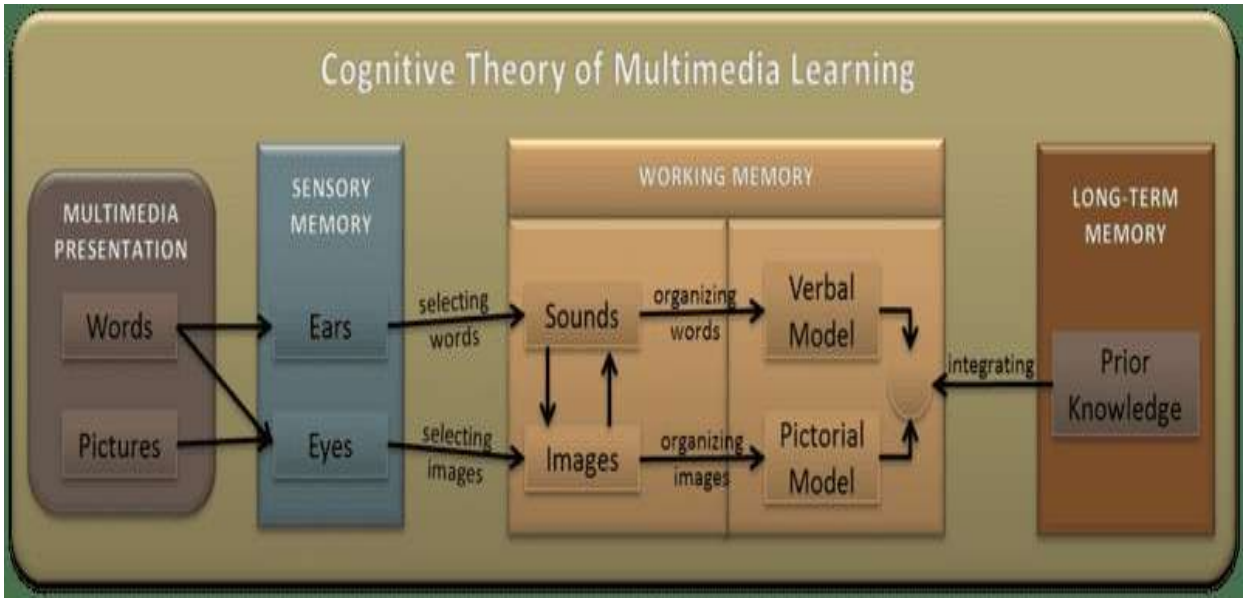

Fig 2.1: Cognitive Theory of Multi-media Learning CTML diagram source

Research by Mayer, (2015) reveals that deeper learning is achieved when the following multi-media combinations are used: text and picture explanations rather than verbal explanations; exclusion of irrelevant words, sounds and video; avoidance of complex verbal and pictorial representations with no guidance for low-prior knowledge learners; and words presented in a personalized conversational style, rather than a detailed description style (Mayer, 2015).

2.7.2 Cognitive-Constructivist Theory of Multi-media Learning

Another relevant theory is the Cognitive-Constructivist Theory of Multi-media Learning. This theory is based on the ideas from branches of cognitive science which state that learning is an active process which involves acquiring new knowledge by building from prior knowledge. This, for example, could mean that a teacher should consider whether the images, animations, pictures and graphics used in a lesson on electrical energy relate to student's prior experiences. It would be an advantage for the learner who has seen electrical sparks to be taught about the energy conversion of electrical to sound and light energy.

2.7.3 Conceptual Framework

The following was the conceptual framework on effect of multi-media in teaching science. In this study, independent variable was multi-media approach in teaching Physics and manipulated variables were achievement and attitude towards Information and Communication Technology (ICT). However, there were other variables such as the type of multi-media resource, level of learner prior knowledge, the learning context, teachers' characteristics, and classroom environment which may affect the expected outcomes which this study restricted to.

2.8 Types of multi-media technologies which can be used in teaching Physics concepts.

There are many types of multi-media technologies which can be used in teaching Physics concepts. These include animation, simulations and augmented reality. Multi-media technology allows you to use several ways of presenting information at the same time. These include text, graphics, animation, video and audio. The most important feature of

multi-media technologies is interactivity, the ability to have a high level of interaction with the user, reader, working in the information environment.

Multi-media are the combination of several means of presenting information into one system. Programs that work with multi-media applications are multimodal, that is, they attract the attention of the audience, as they affect several senses at the same time. The content of the multi-media application is carefully thought out by the author when preparing the scenario and is specified when developing the technological scenario.

2.8.1 Animation

This is a type of multi-media that combines visual and auditory information to create an immersive learning experience (Gordon, 2020). Animation can be used by the teacher to help learners understand complex Physics concepts. It is especially useful as it explains complex phenomena in a step by step manner. This is very helpful when learners encounter a topic that is difficult to visualize. A quick example is when teaching a topic such as electromagnetism or photon movement. Animations can bring complex concepts to life and enhance the learning experience.

There are several types of animation which can be used for teaching Physics such as motion animation which can show how forces move bodies or to demonstrate Newton's laws of motion, or particle animation which can be used to show motion of microscopic particles such as that of photons and the excitation of electrons during the photoelectric effect.

2.8.2 Simulation

The Internet as the largest source, offers thousands of multi-media learning materials for Physics. The most widely used are video materials in the form of computer-generated

simulations and animations and interactive research experiments (Alther, 2019). Multi-media study materials like still and animated graphics; video and audio are confirmed to be much more efficient tools in adopting new knowledge in comparison with traditional methods (Sadaghiani, 2012).

The use of multiple external representations in a multi-media learning environment has been shown to be an effective way to support learning and increase comprehension (Schnotz & Lowe, 2003), which directly relates to the cognitive theory of multi-media learning (CTML), where we can process more than one representation at the same time (Mayer, 2001). Multiple representations are useful in Physics education as they foster students' understanding of Physics problems, building a bridge between verbal and mathematical representations, and helping students to develop images that give meaning to mathematical symbols (Shah & Khan, .2015).

The simulations used in Physics teaching are computer programs that have an implicit model of behavior of a physical system. Learning with computer simulations is closely related to scientific discovery learning, a constructivist approach. The students can interact with the system by changing the parameters to the desired ones and observe the effect of those changes. For example in a simulation of Newton's laws of motion learners can be asked to manipulate various variables such as mass, velocity or acceleration and observe how they affect a body's motion.

An inclusion of visualisations of the forces acting on the object is also possible. Properly designed simulations used in the right contexts can be more effective educational tools than real laboratory equipment, both in developing student facility with real equipment and in fostering student conceptual understanding (Finklestein, Adams, Podolefsky & Reid, 2005). This research will use the ideas and activities from some You-Tube Physics tutorials and the Physics Education Technology Project (PhET) website to find appropriate simulations for varying the instructional approach between traditional and multi-media approach.

2.8.3 Augmented Reality (AR)

This is another type of multi-media that combines virtual objects with the real world. Augmented reality is often confused with virtual reality. Whereupon with AR learners can actually visualize and interact with virtual objects in their actual surroundings, Virtual Reality (VR) creates a completely artificial environment (Alther, 2019).

An example would be to create virtual models of physical systems. A Physics teacher can use AR headsets to show their students a virtual model of the satellite orbits including planets orbiting around the sun. Learners can then manipulate the virtual model by changing the parameters such as the mass or acceleration of satellites in orbit and see how it affects the system. Many other abstract concepts such as electromagnetic fields or the flow of charge can be made concrete and easier to understand using AR.

AR can be very useful in teaching Physics concepts especially in Zimbabwean schools as it can be used to create virtual labs where learners can perform experiments without having to use expensive or dangerous equipment. It can also be used to create virtual science fairs, allowing learners to explore places they might not otherwise be able to visit. The major challenge with the use of AR in Zimbabwe is as good as its advantages. Although it saves money in the long run, the start-up capital required is steep for schools in Harare district.

2.9 Policies

UNICEF, the United Nations Children's Fund, recognizes the importance of multi-media resources in supporting education and child development. Some of their policies related to multi-media resources include:

- Accessibility- UNICEF promotes the use of multi-media resources that are accessible to all children, regardless of their location or socio-economic status. This includes the use of low-cost and low-tech solutions that can reach children in remote and under-resourced areas.

- Partnerships- UNICEF works with governments, NGO's and other organizations to develop and implement multi-media resources that support education and child development.

- Global citizenship- UNICEF promotes the use of multi-media resources that foster a sense of global citizenship and awareness of global citizenship and awareness of global issues and challenges.

- Safe and Ethical use- UNICEF emphasizes the importance of protecting children from online threats and promoting safe and ethical use of technology. This includes promoting digital literacy and media literacy to help children navigate the digital world safely and effectively.

It is worth noting that United Nations Children's Fund (UNICEF's policies and programs related to multi-media resources are guided by their broader mission of supporting children's right and well-being. By promoting the use of multi-media resources, UNICEF aims to support access to high quality education for all children, regardless of their location or background. Furthermore, UNICEF's work in this area aligns with the United Nations Sustainable Development Goals, particularly goal 4: 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.

The World Bank has also launched the eLearning program to support access to education through digital resources. They have provided funding and technical assistance to

developing countries including Zimbabwe to support the implementation of digital learning programs. The United Nations Educational, Scientific and Cultural Organisation (UNESCO) promote the use of Open Education Resources (OERs) to increase access to high quality education materials. Their OER recommendation advocates for the development and use of OERs in education systems worldwide. Khan Academy is another non-profit organization that provides free videos, articles, and interactive exercises, on a wide range of subjects. They have partnered with organizations such as UNESCO and the National Geographic Society to support access to education in under-resourced communities.

The RCZ and POTRAZ are collaborating to promote impactful research and innovation to address national challenges and help the country stain its National Development Strategy 1 goals. According to a 2024 survey which adopted a school-based approach to collect data from children, in partnership with the Ministry of Primary and Secondary Education about 52 % of children between 8 and 18 years had used the internet within 3 months reference period (www://HanyaniNewsOnline). Children cited several barriers to internet use and these included network unavailability, parental restrictions, slow connectivity, high cost of data, cost of devices and power challenges. However it is worrying to note that the study showed about 44% of the children were exposed to sexual content and more needs to be done at the regulatory level. POTRAZ now have the technology to hunt for those who use pseudo names peddling sexual content, cyber bullying and hate speech. This will go a long way to maximize the effects of multi-media resources in teaching Physics concepts if the content is regulated as learners and teachers alike are protected by the Data Protection Act.

2.10 Summary of chapter

This chapter focused on the use of multi-media in teaching Physics concepts. The chapter began by discussing the advantages and disadvantages of using multi-media in teaching

Physics concepts. It then also highlighted the previous studies on effects of multi-media in developed and developing countries such as Zimbabwe. The theoretical framework was presented and a review of literature on the use of different types of multi-media, including animation, simulation and video was done. Finally it concludes by discussing the potential for AR and VR technologies to revolutionise the way Physics concepts are taught in the future.

CHAPTER THREE: RESEARCH METHODOLOGY

3.1 Introduction

This chapter looks at the research design, methodology and methods used to collect data. The population sample will also be explained, clearly illustrating reasons why the sample was suitable for this study on the effects of multi-media resources in teaching Physics concepts. Issues to do with ethics and consent to carry out the research will be highlighted as well as a description of specific data analysis tools and their specificity in the collection of data for this quasi-experimental design.

3.2 Research Design

The study adopted a quasi-experimental design, with one group receiving traditional instruction and another group receiving instruction supplemented with multi-media resources. A quasi-experimental design is one that resembles an experimental design but lacks random assignment of participants to treatment or control groups (Parker, 2020). This means the researcher has limited control over extraneous variables that may affect the outcome. This design will allow for a comparison of the effects of the two teaching methods in enhancing students' understanding of Physics concepts. A Nonequivalent Control Group Design will be conducted, with two groups of students, one group being taught using multi-media resources and the other group being taught using traditional methods. Both groups will be given a pre-test and a post-test to measure their understanding of the Physics concepts being taught. Attempt will be made to control confounding variables such as student motivation and prior knowledge through statistical procedures and matching procedures.

The researcher will use the topic on Newton’s laws of motion to investigate the effects of multi-media resources in teaching Physics concepts. The three laws of motion could be taught using a combination of video clips, animations and interactive simulations. The learners will be asked to complete tasks that require them to apply the laws of motion to real-world scenarios. The pre-test and post-test could then measure the learners’ understanding of the laws of motion before and after the intervention. The experimental group will also have to state the level of importance of key factors such as multimedia relevance, feedback and collaboration in increasing motivation

and engagement when learning physics concepts. A 5 point Likert Scale was used were they simply checked the box with their responses.

3.2.1 Research paradigm

Positivism is a philosophical perspective that is based on the belief that knowledge can be acquired through observation and measurement, and that the world is objective and measurable. It emphasizes the objective reality of the world and the use of quantifiable data to uncover universal truths (May 2019). In this project, the researcher would view the effects of multi-media resources as an objective and measurable phenomenon, and would aim to produce empirical evidence of their effects through mixed research methods such as interviews and tests. From a positivist standpoint, ontology is defined as the belief in an external reality that exists independently of human perception. In the context of our study, this would mean that Physics concepts have an objective existence that can be accurately represented and measured using multi-media resources.

In a journal "The Rise of Positivism" by Richard Hopkin published by the American Philosophical Quarterly (2019), the epistemological perspective is that positivism asserts that knowledge can be discovered through empirical observation and experimentation, leading to the development of theories that accurately explain natural phenomena. From this perspective, the researcher believes that the reality of the effects of the resources exists independently of the researchers' beliefs or values. Knowledge is viewed as objective and value-neutral, and would aim to produce knowledge that is universal and generalizable.

Axiologically, positivism values objectivity, neutrality, and empirical evidence in the pursuit of knowledge (Maya, 2011). From an axiological perspective, the researcher would aim to maintain a value-neutral position and would recognize the potential for personal values and biases to influence the research. To minimize this bias the researcher would ensure that the research methods are transparent and replicable, and that the results are analysed objectively and

rigorously. In this project, the researcher would be aware of their own beliefs and values about the effects of multi-media resources, but would aim to keep these from influencing the research. Overall a positivist approach sees knowledge as objective and measurable, and aims to produce generalizable findings that can be applied in other contexts.

A variety of quantitative methods can be used to test the effects of multi-media resources in teaching Newton's laws of motion using positivist approach. The researcher administered pre and post-test to measure students' understanding of the laws before and after using the resources. The researcher also used interview to measure teachers' perceptions of the resources, and compare the results of different types of resources to identify which are most effective. The data was analysed objectively, using statistical techniques to identify any significant differences between the groups.

3.2.2 Research methodology

The research strategy will specify a quasi-experimental research design. According to Parker, (2020) this method entails that random assignment is not feasible as students at Harare High School are already assigned to classes. This research method may be used when ethical concerns prohibit manipulation of the independent variable (withholding multimedia instruction from a group) and when the researcher wants to study the effect of multimedia in a real-world setting (Shah and Khan, 2018). The design will include a quasi-experimental study comparing the performance of students who receive traditional instruction with those who receive multi-media-enhanced instruction.

Surveys and pre and post-tests will measure the effects of multi-media resources quantitatively whereas in-depth interviews with teachers will measure qualitatively to gain a deeper understanding of how the resources impacted students' learning and perceptions. This provides valuable insights into the factors that influence the effects of the resources and could inform the development of more effective teaching methods. The

quasi-experimental research method design will allow the researcher to gain a more complete understanding of the topic.

Advantages of quasi-experimental design

- High external validity: quasi-experimental designs reflect real-world settings
- Practicality: they are often easier to conduct than experimental designs

Disadvantages of quasi-experimental design

- Limited internal validity: quasi-experimental designs are more susceptible to confounding variables
- Selection bias: groups may differ in ways that affect the outcome

To address these limitations:
The researcher used statistical controls by analyzing covariance (ANCOVA) to control for confounding variables. Confounding variables were also measured by collecting data on factors that could influence the outcome such as prior knowledge, motivationin learning physics, demographics and teacher experience. These were measured through interviews, achievement tests and observations.

3.3 Research strategy

The research strategy involves using a concurrent mixed methods design in which both quantitative and qualitative data are collected and analysed simultaneously. This is achieved through carrying out an exploration into the available multi-media and assign whether they are animation, simulation or augmented reality. The researcher then administers pretest and then a post-test after a lesson on Newton's laws of motion to two groups of a combined 60 learners, one lesson involving use of multi-media resources to 30 learners and the other 30 learners taught using traditional instruction. A 5 point Likert

Scale was used to determine the importance of key factors such as multi-media relevance, feedback and collaboration in increasing motivation and engagement. Only the 30 respondents participated by checking the box and showing the extent of agreement with importance of the factors.

One set of achievement test item constituting of 20 objective type questions related to the selected topics on Newton's Laws of motion was utilized as tool for primary data collection. The questions were in free response format and are included in the appendices below. Scores obtained from both the groups in pretest and post test were compared and also the difference of achievement in physics between control and experimental group were estimated using a suitable statistical techniques i.e.t-test. The one-way analysis of covariance (ANCOVA) technique was also used to get information about the effect of the covariates, such as teacher attitude, on student performance. This was to determine if there was a significant difference between control and experimental group.

Interviews were carried out with 5 Physics teachers from Harare district to determine if attitude of teacher affects teachers' use of multi-media in teaching of Physics concepts. The interviews were recorded and transcribed verbatim, and then coded and analyzed using thematic analysis.

3.4 Research Methods

Research methods to be discussed include how the population was sampled, the data collection tools used and methods employed to collate the data.

3.4.1 Population and Sampling

In research, the population is the entire group that the researcher is interested in studying, while the sample is a subset of that population that is actually included in the study i.e. the participants (Park et al, 2017). A sample of sixity students was selected for the study from the population of Physics students at four purposefully selected high schools in Harare province. Participants were randomly assigned to either the control group (traditional instruction) or the experimental group (multi-media-enhanced instruction).

Stratified sampling was employed in order to obtain the student participants for this study. Marley (2019) posits that stratified sampling involves dividing the population into homogenous subgroups (strata) and then randomly selecting individuals from each subgroup to be included in the sample. In this study, the population consisted of O' level Physics students at Harare Day High School and these were stratified according to gender ensuring that a fair representation of either gender was included in the study.

Purposive sampling or judgmental sampling was also used to acquire the physics teachers who participated in this study. Bias and Mayhew, (2018) define purposive sampling as a non-random sampling method in which participants are selected based on specific criteria that are relevant to the research question and it can help to ensure that the interviews produce rich and relevant data. The researcher selected teachers with experience of using multi-media resources in their classes and who are willing to participate in the study. Only 5 Physics teachers were interviewed from a convenient group in which the researcher could easily acquire relevant information from during the interviews and also by using online platforms which were most accessible such as and Whatsapp groups. A 5 point Likert Scale was also used to determine the importance of key factors such as multi-media relevance, feedback and collaboration in increasing motivation and engagement. Only 30 experimental group respondents participated, by checking a box and showing the extent of agreement. This was because they were the ones who had previously experienced a multi-media aided lesson on Newton's Laws of motion.

3.4.2 Data Collection Instruments

The following data collection tools were used:

1. Achievement Test in Physics (Pre-test and Post-test)

These provide quantitative data on student learning and achievement, which can be used to measure the effects of the multimedia resource package. This data can then be analysed using statistical techniques to determine whether there is a significant difference in learning before and after the use of multimedia resources. All the achievement tests in physics were developed by the researcher.

2. Multi-media Resource Package (video, animation and simulations) on Newton's laws of motion.

This is the main intervention in the study, so it needs to be carefully designed and implemented. The package includes a variety of resources such as animations, videos and interactive activities that align with the learning objectives. Multi-media resource package in physics was also developed by the researcher.

3. Interview guide to determine if teachers' attitude affects use of multi-media in teaching of Physics concepts.

Interviews with physics teachers provide qualitative data on attitudes, perceptions, and experiences related to the use of multi-media resources in Physics instruction

4. The researcher also made use of online platforms such as YouTube tutorials. PheT and Pryce online tutorials to come up with the most efficient Multi-media Resource Package.

3.4.3 Data Analysis Methods

Quantitative data will be analyzed using statistical techniques, such as t-tests and analysis of covariance (ANCOVA), to compare pre- and post-test scores between the control and experimental groups. Qualitative data will be analyzed thematically to identify common patterns and themes in teachers' feedback in interviews to determine if teachers' attitude affects use of multi-media in teaching of Physics concepts. A 5 point Likert Scale was used to determine the importance of key factors such as multi-media relevance, feedback and collaboration in increasing motivation and engagement. Descriptive statistics, such as mean scores on pre and post-test, percentage of students who passed the tests, standard

deviation, and t-value of the scores obtained by the control group and experimental group were used to provide a basic overview of the data and to compare the two groups and look for trends.

Inferential statistics, such as ANCOVA were used to test hypotheses and make predictions about the effects of the resources. ANCOVA allows for the control of one or more continuos variables (covariates) that are believed to influence the dependant variable. An example is students' prior knowledge of Physics concepts which can influence their learning outcomes and this can be measured by pre-test. Another covariate in the study is teacher attitude which can influence the implementation of new instructional materials and methods, as well as the overall learning environment in the classroom. Inferential statistics are used when it is not possible to collect data from the entire population (Park et al, 2017). The researcher used inferential statistics to make generalizations about the effects of multi-media resources in teaching physics concepts based on the data collected from a sample of students. Correlational analysis was used to measure the strength of the relationship between the use of multi-media resources in teaching physics concepts and students' learning outcomes.

3.4.3.1. Justification of methods

Interviews with teachers provided valuable insights into their attitudes and perspectives towards the use of multimedia in teaching physics. This qualitative data can help identify common trends and challenges in implementing multimedia in the classroom. Interviews with teachers were also supplemented with field notes to capture non-verbal cues, observations, and additional insights that may not be captured through audio recordings alone. Field notes provide a more comprehensive understanding of the context in which the interviews take place and help in analyzing the data with a more nuanced perspective. Conducting interviews with a smaller sample size allowed for in-depth exploration of individual experiences and viewpoints, leading to richer qualitative data.

Pre and post tests with students were used to measure the effects of multimedia in enhancing their understanding of physics concepts. This quantitative data can provide empirical evidence on the impact of using multimedia as a teaching tool. Testing 60 students before and after exposure to multimedia provided a substantial sample size to assess the effects of multimedia in teaching physics concepts. This helps in generalizing the findings to a larger student population. Comparing pre and post test scores can offer insights into the impact of multimedia on student learning outcomes and help in evaluating the overall effects of using multimedia as a teaching tool in physics education.

A 5 point Likert Scale was used to determine the importance of key factors such as multi-media relevance, feedback and collaboration in increasing motivation and engagement. Only the 30 experimental group respondents participated by checking a box and showing the extent of agreement on importance of these factors. This was because they were the ones who surely had experienced with multimedia aided learning of physics concepts

3.4.3.2. Time given to participants to respond

Participants were given ample time (1 hour) to respond to interview questions and also 30 minutes for students to complete the pre and post tests to ensure that they can provide thoughtful and accurate answers.

Providing enough time for participants to respond greatly helps reduce the likelihood of rushed or incomplete responses, leading to more reliable and valid data.

3.4.3.3. Collecting instruments from participants

For interviews with teachers, instruments were collected by arranging for face-to-face interviews. Consent was obtained before starting the interview and recordings were made with permission.

For pre and post tests with students, instruments were distributed and collected in a classroom setting. Participation was voluntary and confidentiality maintained to ensure honest responses.

3.5 Reliability and Validity

Reliability, validity, trustworthiness and credibility are important aspects of research design. In the context of the research project on effects of multi-media resources in teaching Physics concepts, reliability refers to consistency and repeatability of the research findings. This means that the results of the research would be consistent if the research was repeated with a different sample or at a different time (Ali and Awan 2013). Validity refers to the accuracy and truthfulness of the research findings. Research findings should accurately represent the effects of multi-media resources in teaching Physics concepts.

3.5.1 Credibility and Dependability

The researcher made sure that the research was carried out in a way that minimizes bias and maximizes the credibility of the findings. Credibility measures the extent to which the findings can be trusted and believed that is they should be sound and consistent with other evidence. The research findings on the effects of multi-media resources in teaching Physics concepts should also be applicable to other contexts and populations such as other schools or different subject areas. The findings of this research will also be dependable and consistent if the research is repeated at a later time.

3.5.2 Objectivity and Bias

Ali and Awan (2013), also define objectivity as the extent to which the research is free from bias and personal judgment. In this case, objectivity would mean that the researcher has taken steps to minimize their own personal bias. To avoid personal bias, the researcher used systematic and transparent approaches to data collection and analysis. Well-defined methods and procedures were used. The researcher also used peer review and feedback from participants and other physics teachers to identify and address potential bias in the research.

3.6 Ethical Issues

The research strategy will address ethical considerations, including obtaining informed consent from participants, ensuring confidentiality and privacy, and upholding ethical standards throughout the study. Participants will be informed of their rights and any potential risks or benefits of participation. For purposes of this research, consent was sought from all the participants, Harare Day High School administration, Pryce Online Tutorials, Bindura University of Science Education (BUSE) and Harare District education.

The researcher is to ensure that all participants, including students and teachers, provide informed consent before participating in the study. They will be well informed about the research objectives, procedures, potential risks and benefits, and their rights to withdraw from the study at any time without penalty. The confidentiality of the participants will be ensured as their identities and personal information are kept secure and confidential. Anonymized data will be used in this study to prevent the identification of individual participants. Privacy of participants will be respected by safeguarding the personal

information collected during the study. Data collected will be stored securely and only accessed by authorized personnel involved in the research such as the study's supervisor.

By addressing these ethical considerations in the research on the effects of multi-media resources in teaching physics concepts, researchers can uphold the principles of integrity, respect, and beneficence in their study. It is essential to prioritize the well-being and rights of participants throughout the research process to ensure the ethical conduct of the study.

3.7 Summary

This chapter looked into the methodology of the research on the effects of multi-media resources in teaching Physics concepts. An overview of the research methods was given, including the sampling methods, data collection methods and data analysis methods. It also highlighted the tools used to collect the data and a discussion of the ethical considerations involved in the study as well as any limitations or challenges that were encountered.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION

This chapter is concerned with data presentation, analysis and discussion of the findings of the study. The data are presented in tabular form, charts and graphs.

4.1 Demographic characteristics

This si part of "biodata" of the partcipants . In research, "biodata" refers to personal history and biographical details used to predict future behavior, performance, and success in various roles. Generally it refers to a person's personal history, including details such as their place of birth, education, family background, and social class. In research its importance lies in its ability to provide a predictive, holistic view of individuals based on past experiences and life events, helping to understand the suitability of individuals to participants in the research study.
Demographic characteristics of the participants was considered under the headings below:

4.1.1 Gender of respondents

The gender of the respondents is listed in the table below. The 5 physics teachers (R1, R2, R3, R4 and R5) and the 60 learners, with 30 in the experimental group and 30 in control group.

Table 4.1 Gender of respondents

Physics Teachers			Learners			
			Experimental Group		Control Group	
Male (R1, R3, R5)	3	60%	18	56%	16	48%
Female (R2, R4)	2	40%	12	44%	14	52%
Total	5	100%	30	100%	30	100%

The tables above shows that respondents R1, R3 and R5 who made up 60% of the physics teachers interviewed were male whilst R2 and R4 i.e. 40% were female. The experimental group consisted of 56% male and 44% female learners whilst the control group consisted of 48% male

and 52% female learners. All respondents chose to participate so there was 100% total respondent participation. This data is presented in the chart below.

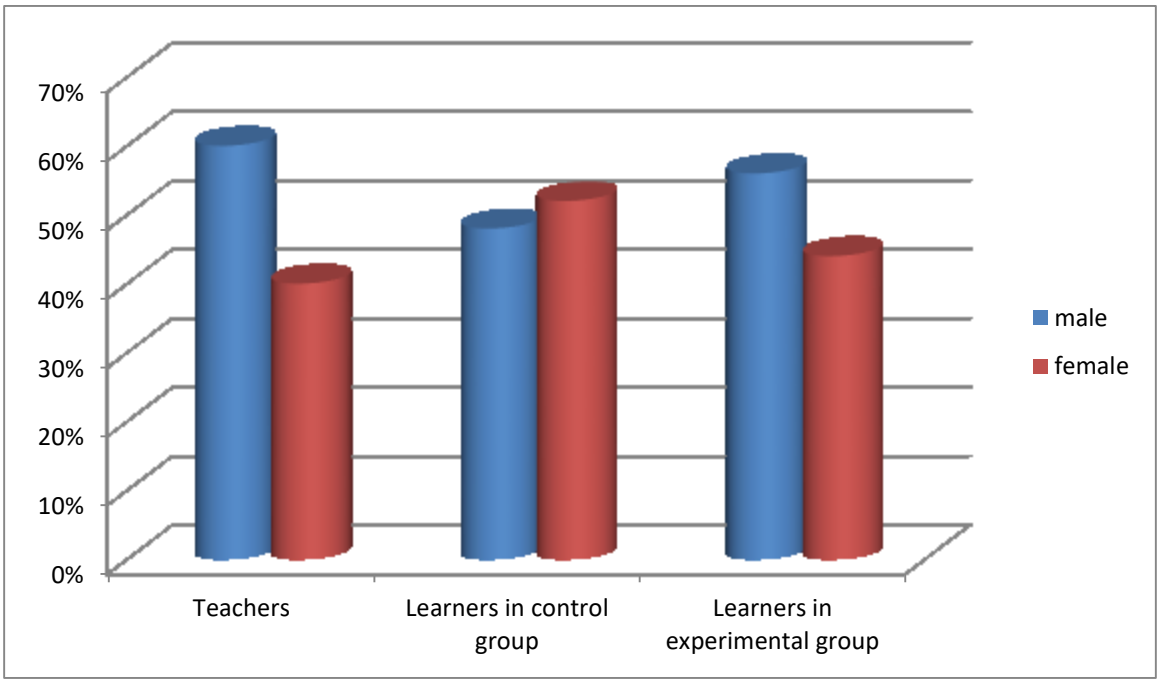

Fig 4.1 Gender of respondents

4.1.2 Age of respondents

The age of all the respondents was also considered and the data presented below.

Table 4.2 Age of respondents

	Frequency	Percent
15-19	60	91.0
20-24	0	0
25-30	2	3.6

30-34	2	3.6
35+	1	1.8

The table above shows the age of the respondents who were interviewed and those who wrote the pre and post test. The majority were physics learners between the ages of 15-19, these constituted 91.0 % of the respondents. There were no respondents between the ages of 20-24 showing the age gap between teachers and learners whilst 3.6 % were between the ages of 25-30 and 30-34. Only 1.8 % of the respondents were above the age of 35. The pie chart below shows this data.

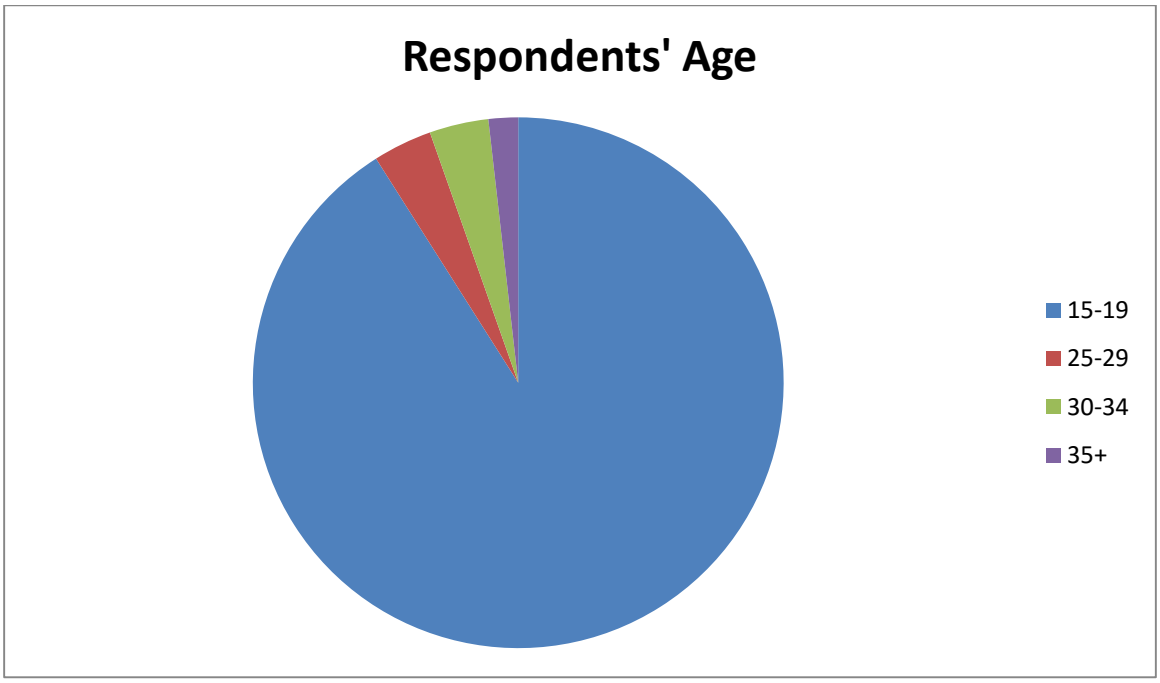

Fig 4.2 Age of respondents

4.1.3 Level of education

The level of education for respondents was also taken account for since it gave insight into the prior knowledge of the learners and level of training on multi-media use in teaching physics concepts. The learners were all ordinary level candidates. The table below shows the data for the teachers' level of education.

Table 4.3 physics teachers' level of education

	Frequency	Percent
Diploma	2	40%
Degree	2	40%
Masters Degree	1	20%

The data on the physics teacher's education level was presented in the pie chart below. An equal number of respondents had a diploma and/or a degree in physics education. These made up 40% of the respondents. Only one respondent (20%) had a master's degree. The teachers' level of education suggests that they had received adequate training in physics and pedagogy. This may indicate that they were all well prepared to teach physics at secondary school level.

TeachT

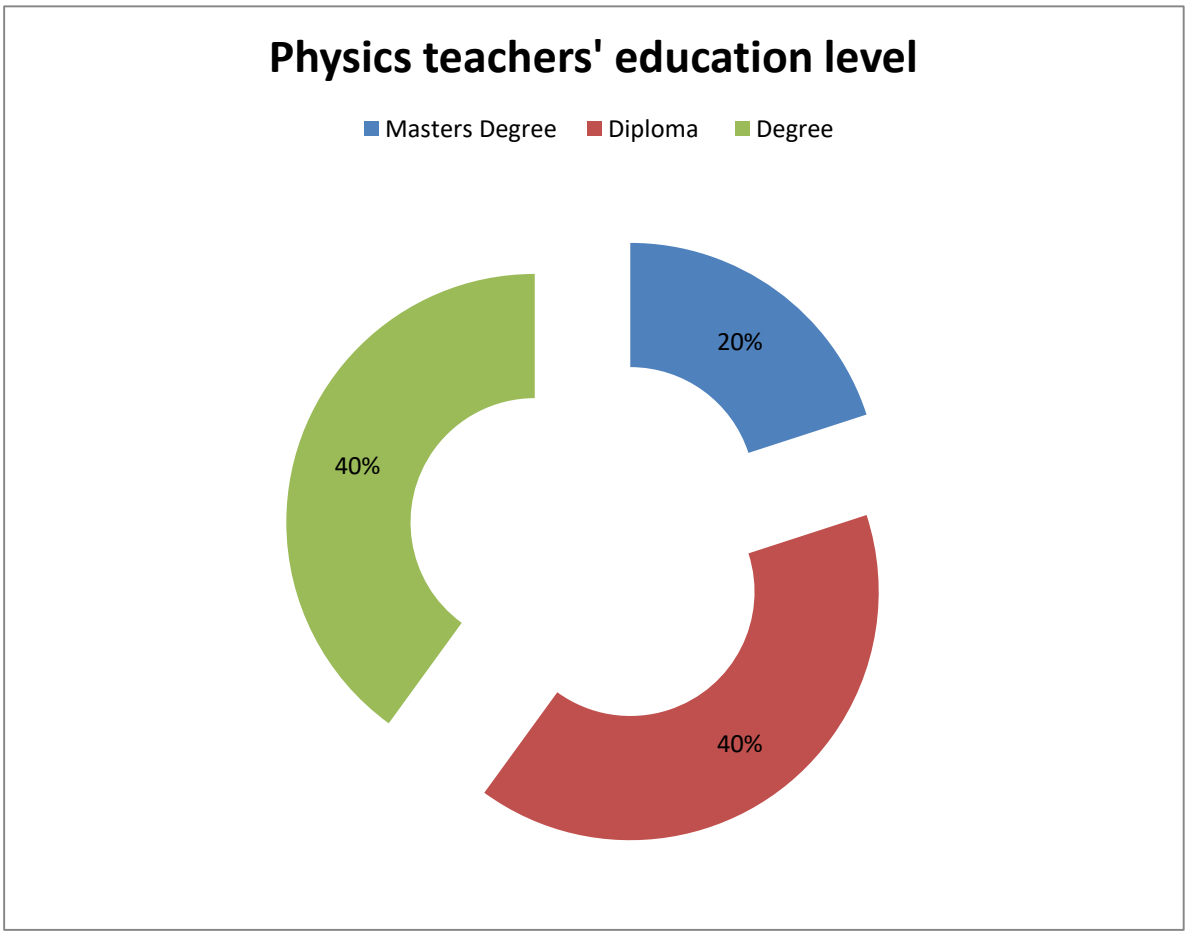

Fig 4.3 physics teachers' level of education

4.2 Answers to research questions

The data analysis involved both qualitative and quantitative methods. The qualitative data was collected through semi-structured interviews with teachers (n=5) who had taught physics using both traditional and multi-media methods. The interviews were recorded and transcribed verbatim.

The quantitative data was collected through a pre-test and post-test assessment of student understanding and retention of physics concepts. The assessment consisted of short-answer questions, which were administered to students (n=60) before and after the instruction. The pre-test and post-test scores were used to calculate the gain score for each student, which was then used to compare the effects of multi-media instruction versus traditional instruction.

4.2.1 Research question 1: What are the attitudes of teachers towards the use of multi-media in teaching physics concepts?

Teachers who have received training on multimedia technology and have experience using it in their teaching practices will have a more positive attitude towards using multi-media in teaching physics concepts. The results below explain on the factors influencing teachers' attitudes towards using multi-media in teaching physics concepts based on the interviews with 5 teachers (R1, R2, R3, R4, and R5) from Harare district which were conducted.

The findings suggest that teachers who have received training on multimedia technology and have experience using it in their teaching practices are more likely to have a positive attitude towards using multi-media in teaching physics concepts. The interviews with 5 teachers revealed that teachers who have received training on multimedia technology were more confident and comfortable using multi-media tools in their teaching practices. For example, R2, who has a background in computer science, mentioned:

"I was trained on multimedia technology during my teacher training program, and it helped me to develop my skills and confidence in using multimedia tools. Now, I use multimedia tools regularly in my teaching practice, and I find it to be an effective way to engage my students and make complex physics concepts more accessible."

On the other hand, teachers who had no prior training or experience with multimedia technology were more likely to have a negative attitude towards using multi-media in teaching physics concepts. For example, Teacher R1 mentioned:

"I'm not familiar with multimedia technology, and I'm not sure how to use it effectively. I'm worried that it might be too complicated for my students, and I'm not sure if it's worth the effort."

The interviews also revealed that teachers who have experience using multi-media tools in their teaching practices were more likely to have a positive attitude towards using multi-media in teaching physics concepts. For example, R5 mentioned:

"I've been using multimedia tools for a few years now, and I've seen how effective they can be in engaging my students and making complex physics concepts more accessible. Now, I use multimedia tools regularly in my teaching practice, and I find it to be an effective way to teach abstract physics concepts."

In contrast, teachers who had no experience using multi-media tools in their teaching practices were more likely to have a negative attitude towards using multi-media in teaching physics concepts. For example, R4 mentioned:

"I've never used multimedia tools before, and I'm not sure if they're worth the effort. I'm worried that it might be too distracting for my students, and I'm not sure if it's an effective way to teach physics concepts."

The findings of this study suggest that training and experience are key factors that influence teachers' attitudes towards using multi-media in teaching physics concepts. Teachers who have received training on multimedia technology and have experience using it in their teaching

practices are more likely to have a positive attitude towards using multi-media in teaching physics concepts. Therefore, it is essential to provide teachers with training and support on using multimedia technology in their teaching practices.

Examples from the interview transcripts:

R 1: *"I'm not familiar with multimedia technology, and I'm not sure how to use it effectively. I'm worried that it might be too complicated for my students, and I'm not sure if it's worth the effort."*

R 2: *"I was trained on multimedia technology during my teacher training program, and it helped me to develop my skills and confidence in using multimedia tools. Now, I use multimedia tools regularly in my teaching practice, and I find it to be an effective way to engage my students and make complex physics concepts more accessible."*

R3*: "I've been using multimedia tools for a few years now, and I've seen how effective they can be in engaging my students and making complex physics concepts more accessible. Now, I use multimedia tools regularly in my teaching practice, and I find it to be an effective way to teach physics concepts."*

R4*: "I've never used multimedia tools before, and I'm not sure if they're worth the effort. I'm worried that it might be too distracting for my students, and I'm not sure if it's an effective way to teach physics concepts."*

R5: *"I've been using multimedia tools for a few months now, and I've seen how effective they can be in engaging my students and making complex physics concepts more accessible. Now, I use multimedia tools regularly in my teaching practice, and I find it to be an effective way to teach physics concepts."*

This study investigated the effects of multi-media in teaching physics concepts and explored the factors that influence teachers' attitudes towards using multi-media in teaching physics concepts. The findings of this study suggest that training and experience are key factors that influence teachers' attitudes towards using multi-media in teaching physics concepts. Teachers who have received training on multimedia technology and have experience using it in their teaching practices are more likely to have a positive attitude towards using multi-media in teaching physics concepts.

The results of this study also suggest that teachers who have received training on multimedia technology and have experience using it in their teaching practices are more likely to use multi-media tools effectively in their teaching practices. This is because they have developed the skills and confidence needed to use multimedia tools, and they are more likely to be familiar with the benefits and limitations of using multimedia technology. The study shows evidence that training and experience are key factors that influence teachers' attitudes towards using multi-media in teaching physics concepts. The findings of this study suggest that providing teachers with training and support on using multimedia technology is essential for promoting the effective use of multi-media in teaching physics concepts.

4.2.2 Research question 2: What is the relationship between the use of multimedia in teaching physics concepts and academic achievement?

Data from the pre and post-test was collected to find the relationship between the use of multi-media in teaching physics concepts and academic achievement. The collected data were tabulated and manipulated statistically. To find the significant difference between the experimental and control groups, the developed null hypotheses were tested at p (0.05). The sample (N) mean (μ), degrees of freedom (DF), and t-values for the pre and post test scores were calculated and are given in the tables below.

4.2.2.1 Pre-test Score analysis

The table below gives the comparison between the performance of the experimental and control groups before treatment.

Table 4.4 Scores of the Experimental Group and the Control Group before treatment (Pre-test Score)

Group	Sample (N)	MEAN (μ)	DF	t-value	p (0.05)
The experimental group	30	30.27	58	0.92	0.92<2.01
The control group	30	32.07			

Non-significant at α = 0.05.

As shown in Table, the calculated t-value is less than the table value (calculated value = 0.92 vs. table value = 2.01), so there are no significant differences (at $\alpha = 0.05$) between the achievement scores of the experimental group and the control group before treatment. The hypothesis is accepted. It means that both groups are the same before treatment.

4.2.2.2 Post-test Score analysis

The table below gives the comparison between the performance of the experimental and control groups after treatment.

Table 4.5 Scores of the experimental group and the control group after treatment (Post-test Score).

Group	N	MEAN	DF	t-value	p (0.05)
The experimental group	30	39.03	58	3.50	3.50 > 2.01
The control group	30	33.27			

Significant at $\alpha = 0.05$

Table 4 .5 shows that there is a significant difference in the mean scores of the experimental group and the control group. The calculated t-value (3.50) is greater than the table t-value (2.01) at a significant level of 5%. There is a significant difference in the achievement scores of the control and experimental groups after treatment. The hypothesis is rejected. It means that multimedia aided teaching is more effective than the traditional method of teaching.

4.2.2.3 Pre and Post-test analysis

It can be seen that the experimental group gained more than the control group. Gain of the experimental group is 8.76 (39.03-30.27), whereas gain of the control group is 1.20 (33.27-32.07). This is illustrated in the figure below.

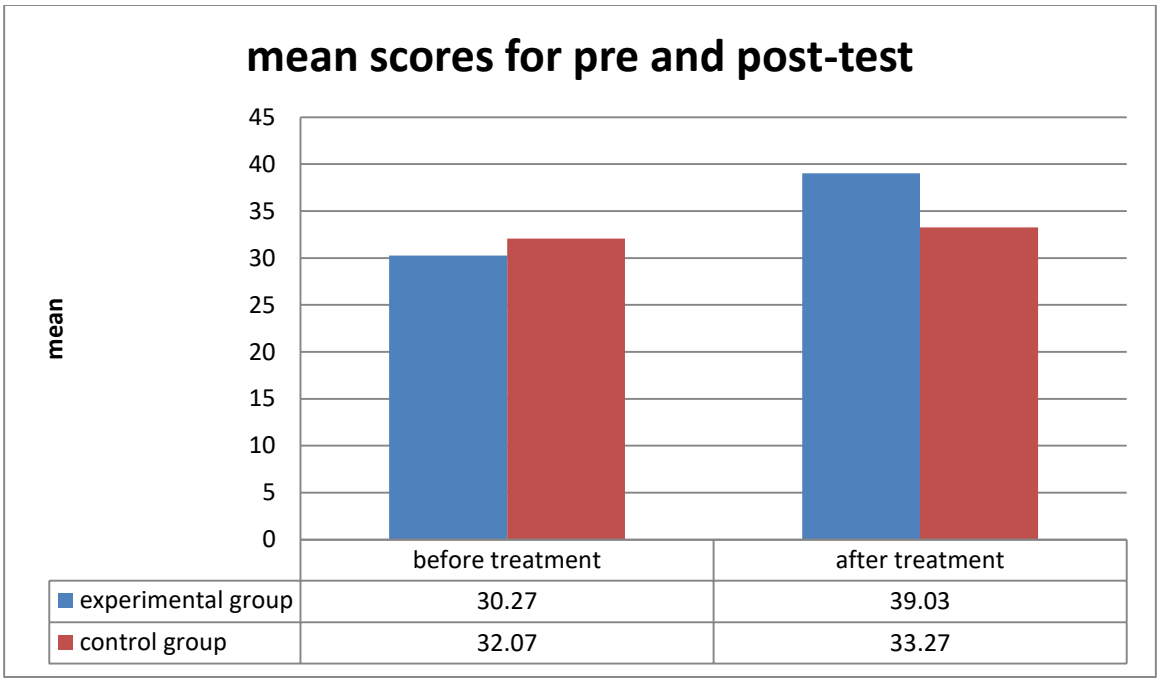

Fig 4.4 Academic achievement of the experimental and control group

There is a significant difference in the achievement scores (gains) of both groups. This shows the positive impact of multimedia teaching on students' academic achievement. Similarly, a study by Adeyanju, (2005) found that students who were exposed to multi-media presentations of Physics concepts scored higher on post-tests compared to those who received traditional instruction. Similarly, a meta-analysis by Brown et al. (2018) found that multi-media interventions were associated with significant gains in student achievement in Physics.

4.2.3 How important are factors such as multi-media relevance, feedback and collaboration when teaching physics concepts in increasing student motivation and engagement?

Students were asked on the importance of factors such as relevance, feedback and collaboration in increasing student motivation and engagement when using multi-media to teach physics concepts... They were supposed to tick one box if they strongly agreed that the factor was important, agreed, were neutral, disagreed or strongly disagreed. The answers were guided and

based on a 5-point Likert scale. The range of the scale was from SA = “Strongly agree”, A = “Agree”, N = “Neutral”, D = “Disagree”, to SD = “Strongly disagree”. Only the 30 respondents from the experimental group were involved as respondents, as they had experienced a prior multi-media aided lesson on Newton’s laws of motion. A total of 90 responses were therefore made, with 30 responses on the extent of agreement on importance of relevance, 30 on importance of feedback and 30 on importance of collaboration.

Table 4.6 Importance of relevance, feedback and collaboration in learner motivation and engagement.

	Responses					Total responses
	SA	A	N	D	SD	
Relevance	15	7	5	2	1	30
Feedback	13	10	4	2	1	30
Collaboration	7	7	11	4	1	30
Total	35	24	20	8	3	90
Percentage %	38.9	26.7	22.2	8.9	3.3	100

On relevance, feedback and collaboration, 35 students, 38.9% of the respondents reported that they strongly agreed that these were important factors that influenced their motivation and engagement in learning physics concepts. 26.7% (24 students) of the respondents only agreed, 22.2% (20 students) were neutral, 8.9% (8 students) disagreed and only 3.3 % (3 students) strongly disagreed on the importance of these factors in influencing motivation and engagement in learning physics concepts. This data is presented in the chart below.

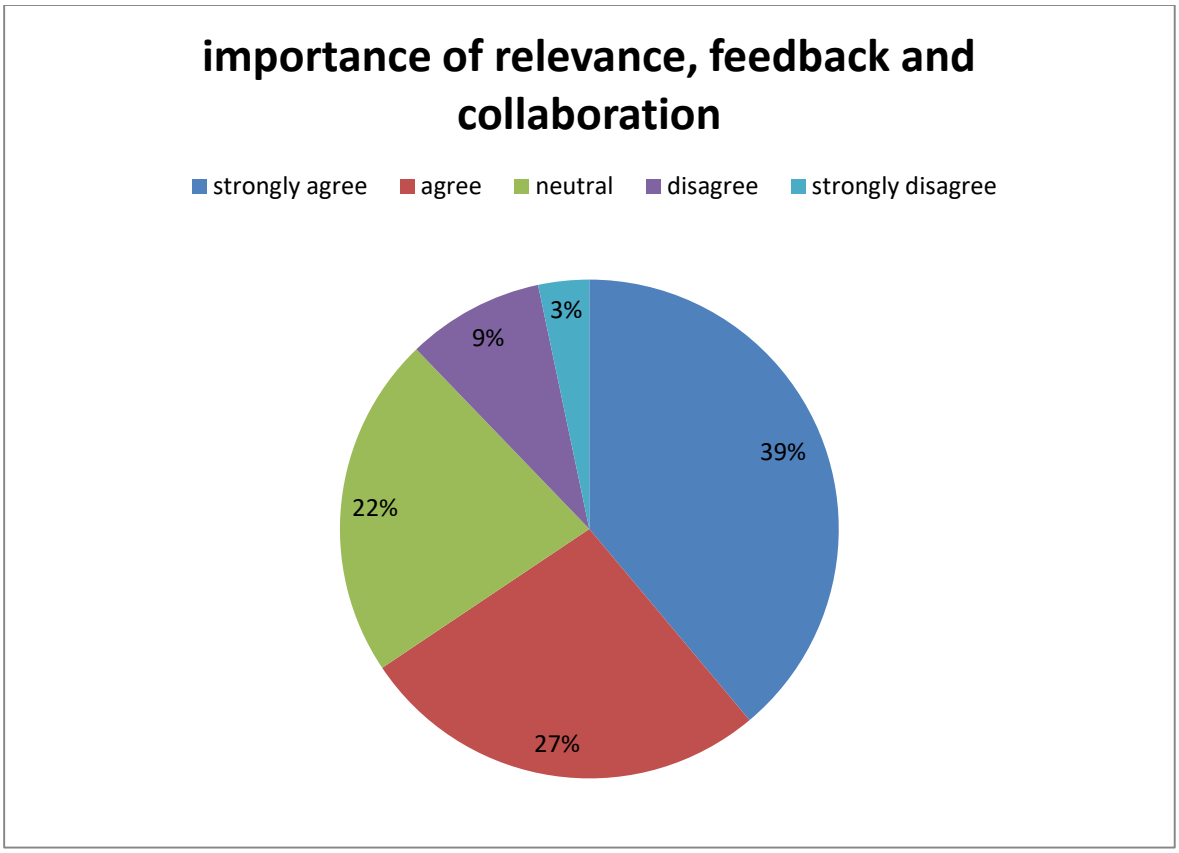

Fig 4.5 Importance of factors that influence motivation and engagement

Students reported that they were more motivated to learn physics when they saw how it applied to their everyday lives. They also reported how they valued feedback from teachers on their understanding and progress, as it helped them to stay motivated and engaged. Students reported that working with peers on group projects helped them to stay motivated and engaged, as they felt more accountable to their peers.

4.3 Summary of chapter

This chapter presented the findings of the study on the effects of multi-media in teaching physics concepts. The results are based on the data collected from the experiment, which involved a control group and an experimental group of students who were taught using traditional methods and multi-media methods, respectively. The results show that the experimental group that was taught using multi-media methods significantly outperformed the control group in terms of their understanding and retention of physics concepts. Specifically, the experimental group showed a higher mean score on the post-test, with a significant difference ($p < 0.05$) compared to the control group. This suggests that the use of multi-media in teaching physics concepts is effective in improving student learning outcomes.

The analysis also reveals that the experimental group showed greater improvement in their problem-solving skills and ability to apply physics concepts to real-world scenarios. This suggests that the use of multi-media may be particularly effective in developing students' critical thinking and analytical skills. In addition, the results show that students in the experimental group reported higher levels of engagement and motivation, as well as a greater sense of enjoyment and interest in learning physics. This suggests that the use of multi-media may be an effective way to promote student engagement and motivation in physics education.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The teaching of physics concepts has undergone a significant transformation in recent years, thanks to the advent of multimedia technology. The traditional lecture-based approach has given way to a more engaging and interactive method of instruction, where multimedia tools such as videos, animations, simulations and games are used to convey complex physics concepts in an easy-to-understand manner. The purpose of this study was to investigate the effects of multi-media in teaching physics concepts. The research aimed to explore the impact of multimedia on students' understanding, retention, and interest in learning physics concepts and how it can be integrated into the curriculum to promote a deeper and more meaningful experience. The results of this study provide valuable insights into the potential benefits and limitations of using multi-media in teaching physics.

5.2 Summary of the study

This comprehensive study investigated the effects of multimedia instruction on student learning outcomes and teacher attitudes in teaching physics concepts. The findings of this study suggest that multi-media can be an effective tool in teaching physics concepts. The results indicate that students who received multimedia instruction scored significantly higher on the post-test than those who received traditional instruction. Additionally, the students who received multimedia instruction showed higher levels of engagement and interest in the learning process.

The results also suggest that the type of multimedia used can have an impact on student learning outcomes. The use of interactive simulations and animations was found to be particularly effective in enhancing student understanding and retention of physics concepts. The findings also suggest that the use of multimedia can help to reduce the achievement gap between students with different levels of prior knowledge and experience.

Moreover, teachers who received training on multimedia instruction demonstrated more positive attitudes towards using technology in the classroom, highlighting the importance of teacher training and support in effectively integrating technology into pedagogical practices. The study also identified key factors that influenced student motivation and engagement, including relevance, feedback and collaboration. The multimedia instruction on Newton's Laws of motion was designed to provide students with relevant and real-world examples of physics applications, timely feedback on their progress, and opportunities for collaborative problem-solving. These elements were found to be crucial in fostering an engaging and motivating learning environment.

The findings of this study have important implications for physics education highlighting the potential of multimedia instruction to improve student learning outcomes and teacher attitudes. The study's results suggest that:

- Students who receive multimedia instruction perform better in physics compared to traditional instruction.
- Teachers' attitudes towards technology improve with training and experience
- Relevance, feedback, and collaboration are essential factors in multimedia instruction that influence student motivation and engagement.
- Teacher training and support are critical in effective integration of technology in the teaching of physics concepts.

Overall, this study demonstrates the effects of multimedia instruction in enhancing physics education and emphasizes the need for teacher training and support to harness the full potential of technology in promoting student learning and engagement.

5.3 Conclusions/ Answers to research questions

In conclusion, this study demonstrates the effects of multimedia instruction in enhancing the teaching of physics concepts. The findings highlight the importance of teacher training and

support in harnessing the power of technology to improve student learning outcomes and teacher attitudes. The study's results have important implications for the teaching of seemingly abstract physics concepts, emphasizing the need for relevance, feedback, and collaboration in multimedia instruction to promote student motivation and engagement.

5.3.1 On the attitudes of teachers towards the use of multi-media in teaching physics concepts

This study provides evidence that training and experience are key factors that influence teachers' attitudes towards using multi-media in teaching physics concepts. The findings of this study suggest that providing teachers with training and support on using multimedia technology is essential for promoting the effective use of multi-media in teaching physics concepts. The study highlights the importance of providing teachers with training and support on using multimedia technology in their teaching practices. This is because teachers who have received training on multimedia technology and have experience using it in their teaching practices are more likely to have a positive attitude towards using multi-media in teaching physics concepts.

The results of this study also suggest that teachers who have received training on multimedia technology and have experience using it in their teaching practices are more likely to use multi-media tools effectively in their teaching practices. This is because they have developed the skills and confidence needed to use multimedia tools, and they are more likely to be familiar with the benefits and limitations of using multi-media tools effectively in the teaching of physics concepts.

5.3.2 On the relationship between the use of multimedia in teaching physics concepts and academic achievement?

The results of the pre-test and post test analysis showed that the experimental group which was taught using multimedia gained more than the control group which was taught using traditional instruction. The calculated t-value is less than the table value (calculated value = 0.92 vs. table value = 2.01), so there are no significant differences (at $\alpha = 0.05$) between the achievement scores of the experimental group and the control group before treatment. The hypothesis is accepted. It means that both groups are the same before treatment.

Gain of the experimental group is 8.76 (39.03-30.27), whereas gain of the control group is 1.20 (33.27-32.07). The calculated t-value (3.50) is greater than the table t-value (2.01) at a significant level of 5%. There is a significant difference in the achievement scores of the control and experimental groups after treatment. There is a significant difference in the achievement scores of the control and experimental groups after treatment. The hypothesis is rejected. It means that multimedia aided teaching is more effective than the traditional method of teaching.

5.3.3 On importance of factors such as multi-media relevance, feedback and collaboration when teaching physics concepts in increasing student motivation and engagement.

Relevance, feedback and collaboration were found to be crucial elements in multimedia instruction as they helped students to see the connection between physics concepts and real-life applications. Quick feedback in form of sound and subtitles on videos, pausing videos and playback when students wanted to listen again was found to be effective in the teaching f physics concepts. Students reported that they were more motivated to learn physics when they saw how it applied to their everyday lives. They also reported how they valued feedback from teachers on their understanding and progress, as it helped them to stay motivated and engaged. Students reported that working with peers on group projects helped them to stay motivated and engaged, as they felt more accountable to their peers.

5.4 Recommendations

The findings of this study have important implications for teaching and learning physics. The results suggest that teachers should consider incorporating multimedia into their teaching practices to enhance student learning outcomes. Additionally, the findings suggest that teachers should consider using interactive simulations and animations to engage students and enhance their understanding of physics concepts.

The study also highlights the importance of providing students with opportunities to practice and apply their knowledge through interactive activities. The use of multimedia can provide a platform for students to engage in hands-on activities, such as simulations, games, and virtual labs, which can help to deepen their understanding of physics concepts. Also, Based on the findings of this study, the following recommendations are further made:

- Provide teachers with training on multimedia technology as part of their teacher training program.
- Provide teachers with ongoing support and resources to help them develop their skills and confidence in using multimedia technology.
- Encourage teachers to use multi-media tools regularly in their teaching practices.
- Provide teachers with opportunities to share their experiences and best practices for using multi-media tools in teaching physics concepts.
- Conduct further research on the effects of multi-media in teaching physics concepts and explore new ways to promote the effective use of multi-media in teaching physics concepts.

By implementing these recommendations, educators can promote the effective use of multi-media in teaching physics concepts and provide students with engaging and interactive learning experiences.

5.4.1 Limitations and Future Research Directions

While this study provides valuable insights into the effects of multi-media in teaching physics, there are several limitations that should be considered. The study was limited to a small sample size at Harare High School and may not be generalizable to other populations or contexts. Additionally, the study relied on self-reported measures of student engagement and interest, which may not be entirely accurate.

The study's limitations suggest avenues for future research. Future studies could explore the use of new technologies, such as virtual reality or artificial intelligence (AI) in the teaching of physics concepts. Additional limitations of the research include:

- Sample size- the study only included 60 students and 5 teachers, which may not be representative of the larger population

- Limited demographics- the study only included students from one school district , which may not be generalizable to other districts or regions
- Short duration- the study only lasted across two semesters which may not be long enough to capture the full impact of multimedia instruction.
- Limited measures- the study only used tests and tests and interviews to measure student outcomes, which may not capture other important aspects of learning such as critical thinking and problem-solving skills.
- Limited control group- the control group only received traditional instruction, which may not be a accurate representation of the current state of physics education
- Lack of longitudinal data- the study did not collect data on long-term retention or application of physics concepts, which is an important aspect of learning physics concepts (Shar and Khan, 2018)

By acknowledging and addressing these limitations, future research can build upon this study and provide a more comprehensive understanding of the effects of the effects of multimedia in teaching physics concepts.

Future research directions include investigating the effects of multi-media in teaching other subjects, such as mathematics and biology. Additionally, researchers could investigate the use of multimedia in teaching physics concepts to students with special needs or English language learners. This study investigated the effects of multi-media in teaching physics concepts and explored the factors that influence teachers' attitudes towards using multi-media in teaching physics concepts. The findings of this study suggest that training and experience are key factors that influence teachers' attitudes towards using multi-media in teaching physics concepts. Previous studies have shown that multimedia can enhance student engagement and motivation in learning physics (Kulm & Libarkin, 2016). However, there is limited research on the effects of multimedia in teaching specific physics concepts. This study aims to address this gap by investigating the effects of multimedia in teaching physics concepts.

The study's results have practical implications for physics education. Educators and policy makers can use the findings to inform decisions about the use of multimedia instruction in physics classrooms. The results of the study suggest that investing in teacher training and support, and incorporating relevance, feedback, and collaboration into multimedia instruction, can improve student learning outcomes and teacher attitudes.

In conclusion, this study provides evidence that multi-media can be an effective tool in teaching physics concepts. The findings suggest that teachers should consider incorporating multimedia into their teaching practices to enhance student learning outcomes. The study highlights the importance of providing students with opportunities to practice and apply their knowledge through interactive activities. While there are limitations to this study, the findings provide valuable insights into the potential benefits and limitations of using multi-media in teaching physics.

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APPENDICES

Interview Guide:

Part 1: Background and Experience

Age.....

Educational
background.....

.....

1. Can you tell us a bit about your background in physics education and your experience teaching physics concepts?

2. What are your current teaching methods and approaches to teaching physics concepts?

Part 2: Attitudes towards Multi-Media in Teaching Physics Concepts

1. What are your thoughts on using multi-media (e.g., videos, animations, simulations) in teaching physics concepts?

2. How do you currently incorporate multi-media into your teaching practices?

3. Do you think multi-media is effective in teaching physics concepts? Why or why not?

Part 3: Students' Understanding and Retention

1. How do you think students understand and retain physics concepts when taught using multi-media compared to traditional teaching methods?

2. Have you noticed any differences in students' engagement and motivation when taught using multi-media versus traditional methods?

3. Can you provide any specific examples of how students have responded to multi-media in your classes?

Part 4: Factors Influencing Student Motivation and Engagement**

1. What factors do you think influence students' motivation and engagement in learning physics concepts using multi-media?

2. Do you think the level of interactivity or hands-on experience is important in engaging students with multi-media?

3. How do you think students' prior knowledge and understanding of physics concepts affect their motivation and engagement with multi-media?

Part 5: Challenges and Future Directions**

1. What challenges have you faced in implementing multi-media in your teaching practices?

2. How do you think technology can be improved to better support the teaching of physics concepts?

3. Are there any specific areas or topics in physics that you think would particularly benefit from the use of multi-media?

Interview Questions:

1. What is your experience with using multimedia resources such as videos, animations, and simulations in your teaching? Can you give an example of how you have used one of these resources in a lesson?

2. How do you think multimedia resources can help students understand complex physics concepts such as relativity or quantum mechanics?

3. Have you noticed any differences in student engagement and motivation when using multimedia resources compared to traditional teaching methods? Can you give an example of a lesson where this was particularly noticeable?

4. What are some common challenges you face when using multimedia resources in your teaching, and how do you overcome these challenges?

5. Can you think of any specific multimedia resources that you have found particularly effective in teaching physics concepts? Why did they work well?

NB: The interview questions are designed to be open-ended, allowing teachers to share their thoughts and experiences in detail. The guide is meant to be flexible, and teachers may be asked to elaborate on their answers or provide additional information as needed.

Pre-Test Questions

1. What is Newton's First Law of Motion?

2. What is meant by the term "inertia" in physics?

3. Can you describe an example of an object that is in motion?

4. How does the force of friction affect the motion of an object?

5. What is the difference between a force and a push?

6. Can you explain why an object will continue to move in a straight line if no force is acting on it?

7. What is Newton's Second Law of Motion?

8. How does the force applied to an object affect its acceleration?

9. Can you describe an example of an object that is accelerating?

10. How does the mass of an object affect its acceleration when a force is applied?

11. What is the concept of "mass" in physics?

12. Can you explain why a heavier object requires more force to accelerate it than a lighter object?

13. What is Newton's Third Law of Motion?

14. Can you describe an example of an action-reaction pair of forces?

15. How does the force exerted by one object on another affect the motion of both objects?

16. Can you explain why an object will not move if there is no net force acting on it?

17. What is meant by the term "net force" in physics?

18. How does the force of gravity affect the motion of an object on Earth?

19. Can you describe an example of an object that is in equilibrium?

20. How does the concept of inertia relate to the concept of equilibrium?

Post-Test Questions

1. What is the difference between a force and a push, and how do they relate to Newton's First Law of Motion?

2. Can you explain why an object will accelerate when a force is applied to it, and how this relates to Newton's Second Law of Motion?

3. How do you think the concept of mass affects the motion of an object, and how can you demonstrate this in an experiment?

4. What are some examples of action-reaction pairs of forces, and how do they demonstrate Newton's Third Law of Motion?

5. Can you describe an example of an object that is in motion, and how its motion is affected by the forces acting on it?

6. How does the concept of inertia relate to real-world situations, such as driving a car or riding a bicycle?

7. What are some examples of how Newton's Laws of Motion are used in everyday life, such as in engineering or sports?

8. Can you explain why an object will not move if there is no net force acting on it, and how this relates to Newton's First Law of Motion?

9. How do you think technology can be used to improve our understanding of Newton's Laws of Motion, and how can we apply this knowledge to real-world problems?

10. Can you describe an example of an object that is in equilibrium, and how its motion is affected by the forces acting on it?

11. What are some common misconceptions about Newton's Laws of Motion, and how can we address these misconceptions in our teaching practices?

12. How do you think student-centered learning activities, such as simulations or games, can be used to teach Newton's Laws of Motion, and what benefits do these activities offer for students' learning experiences?

13. Can you explain why an object will accelerate when a force is applied to it, and how this relates to Newton's Second Law of Motion?

14. How do you think teachers can use multimedia resources to teach Newton's Laws of Motion, and what benefits do these resources offer for students' learning experiences?

15. What are some examples of how students can use data analysis to investigate Newton's Laws of Motion, and what benefits do these activities offer for students' learning experiences?

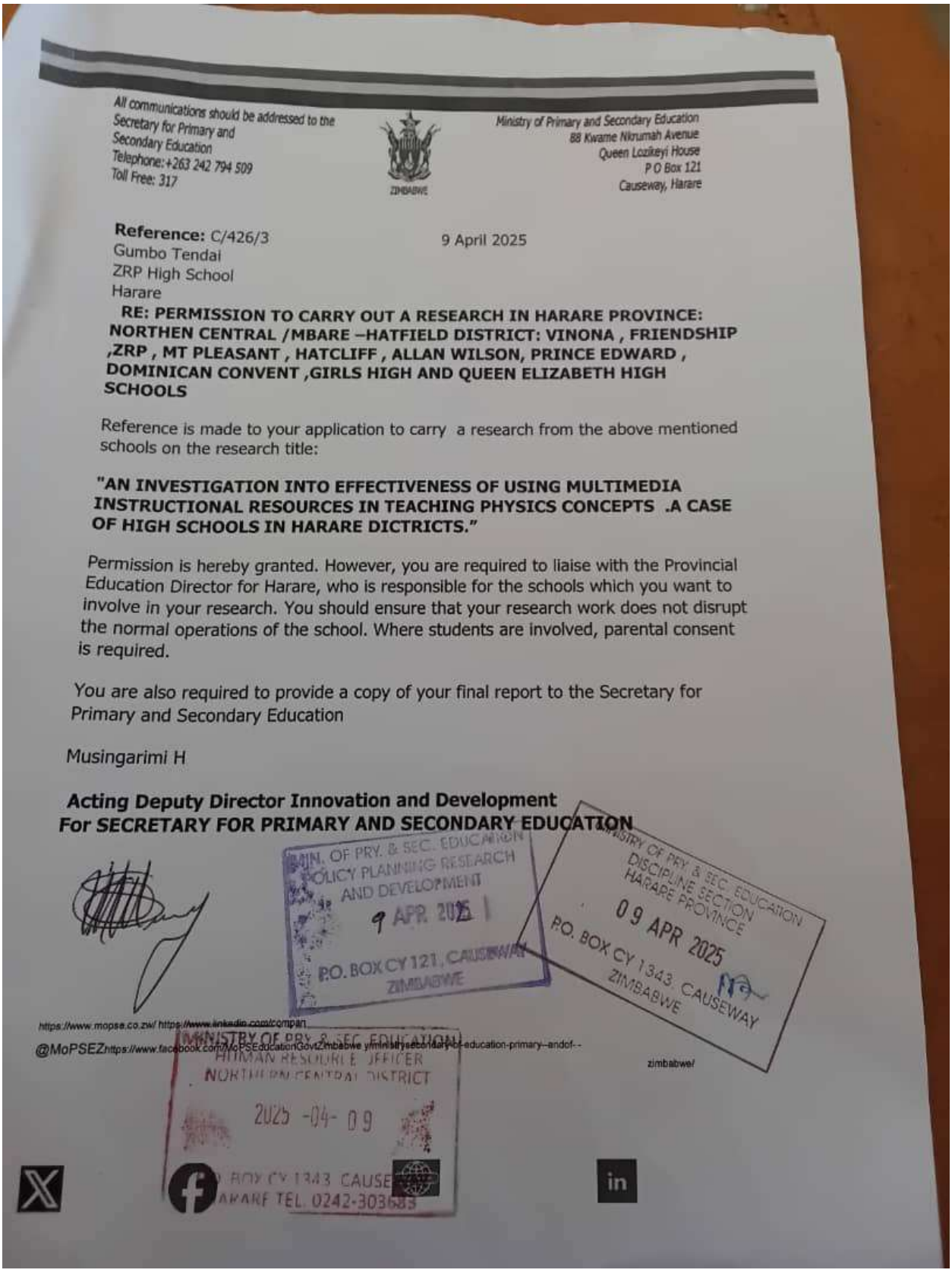
16. Can you describe an example of an object that is in motion, and how its motion is affected by the forces acting on it.

17. How do you think technology can be used to improve our understanding of Newton's Laws of Motion, and how can we apply this knowledge to real-world problems.

18. What are some common misconceptions about Newton's Laws of Motion, and how can we address these misconceptions in our teaching practices.

19. Can you explain why an object will not move if there is no net force acting on it, and how this relates to Newton's First Law of Motion.

20. How do you think multimedia resources can be used to improve our understanding of Newton's Laws of Motion, and what benefits do these resources offer for students' learning experiences.



All communications should be addressed to the Secretary for Primary and Secondary Education
Telephone: +263 242 794 509
Toll Free: 317

ZIMBABWE

Ministry of Primary and Secondary Education
88 Kwame Nkrumah Avenue
Queen Lozikeyi House
P O Box 121
Causeway, Harare

Reference: C/426/3
Gumbo Tendai
ZRP High School
Harare

9 April 2025

RE: PERMISSION TO CARRY OUT A RESEARCH IN HARARE PROVINCE: NORTHEN CENTRAL /MBARE –HATFIELD DISTRICT: VINONA , FRIENDSHIP ,ZRP , MT PLEASANT , HATCLIFF , ALLAN WILSON, PRINCE EDWARD , DOMINICAN CONVENT ,GIRLS HIGH AND QUEEN ELIZABETH HIGH SCHOOLS

Reference is made to your application to carry a research from the above mentioned schools on the research title:

"AN INVESTIGATION INTO EFFECTIVENESS OF USING MULTIMEDIA INSTRUCTIONAL RESOURCES IN TEACHING PHYSICS CONCEPTS .A CASE OF HIGH SCHOOLS IN HARARE DICTRICTS."

Permission is hereby granted. However, you are required to liaise with the Provincial Education Director for Harare, who is responsible for the schools which you want to involve in your research. You should ensure that your research work does not disrupt the normal operations of the school. Where students are involved, parental consent is required.

You are also required to provide a copy of your final report to the Secretary for Primary and Secondary Education

Musingarimi H

Acting Deputy Director Innovation and Development
For SECRETARY FOR PRIMARY AND SECONDARY EDUCATION

MIN. OF PRY. & SEC. EDUCATION
POLICY PLANNING RESEARCH AND DEVELOPMENT
9 APR 2025
P.O. BOX CY 121, CAUSEWAY
ZIMBABWE

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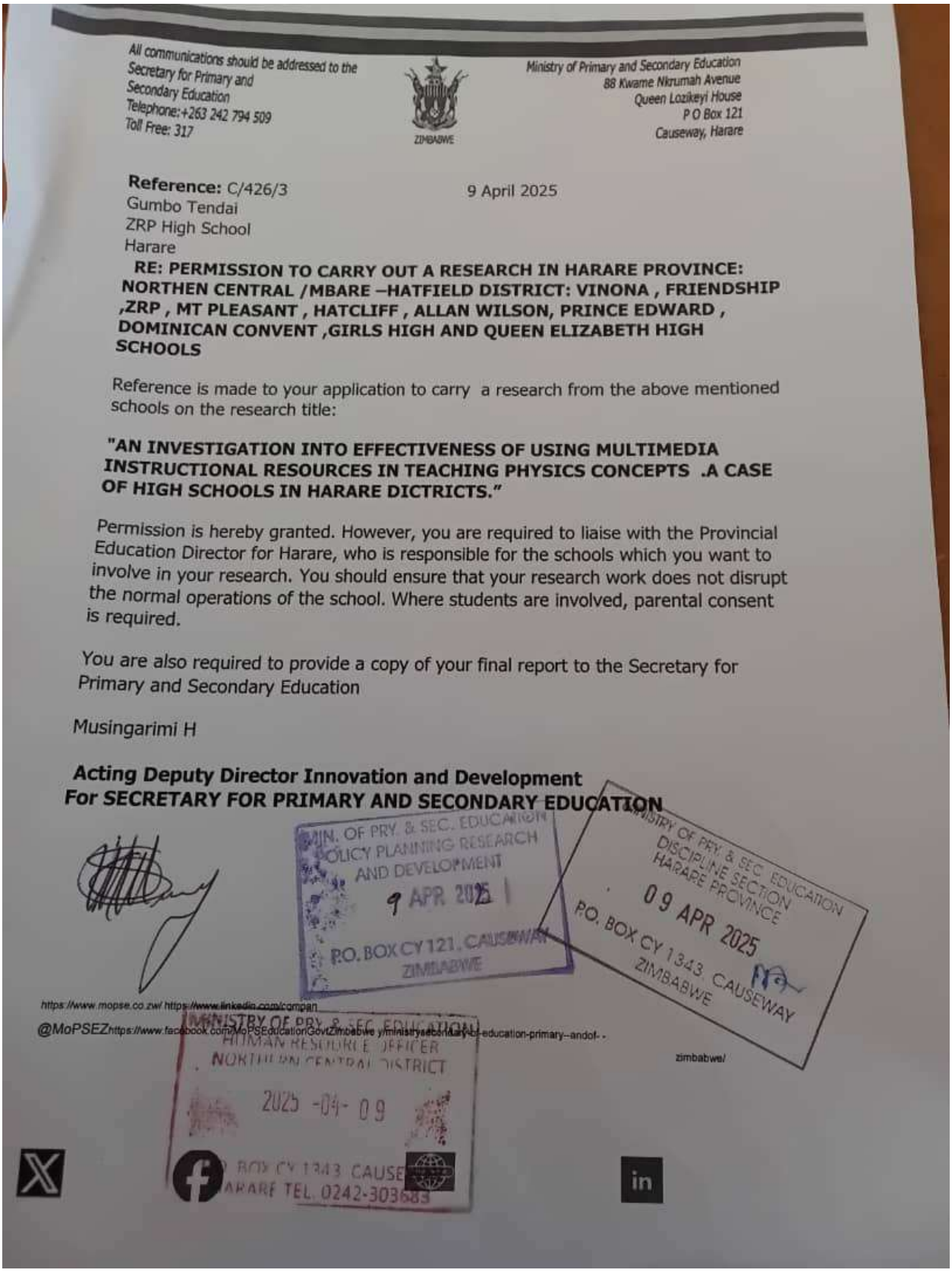
MINISTRY OF PRY. & SEC. EDUCATION
HUMAN RESOURCE OFFICER
NORTHERN CENTRAL DISTRICT
2025 -04- 09
P O BOX CY 1343 CAUSE
HARARE TEL 0242-303683



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