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BACHELOR OF SCIENCE EDUCATION HONOURS DEGREE IN BIOLOGY

ASSESSING THE BENEFITS OF MICRO SCIENCE KITS ON PRACTICAL SKILLS DEVELOPMENT IN BIOLOGY STUDENTS. A CASE OF MATSINE SECONDARY SCHOOL IN HWEDZA DISTRICT, MASHONALAND EAST PROVINCE.

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DECLERATION

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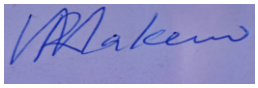  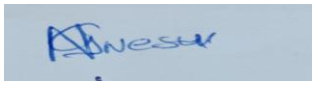

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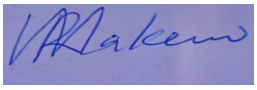

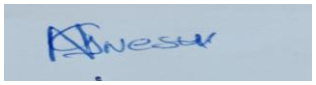

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DEDICATION

I dedicate this project to my family and friends for supporting physically, socially as well as financially. I thank you for the guidance. You made my academic a success. Without you it would not be possible. My special gratitude to my spouse for giving me time to study.

Abstract

This action research study, employing a qualitative approach, explores the benefits of using micro science kits in developing practical skills among Biology students. A sample of 19 participants, including 16 students and 3 teachers from Matsine Secondary School in Zimbabwe, were involved in the study. Through in-depth interviews, observations, and questionnaire, the research gathered rich, contextual data on the effectiveness of micro science kits in enhancing learners' engagement, practical skills development, and understanding of biological concepts. The findings reveal that micro science kits provide hands-on opportunities for students to practice core biological techniques, fostering confidence and deeper understanding. The kits were found to be cost-effective, democratizing access to practical biology education, particularly in under-resourced schools. Students and teachers reported significant benefits, including improved practical skills, scientific inquiry skills, and increased learner engagement. The study's results have implications for science education, highlighting the potential of micro science kits to address inequalities in education and enhance the quality of science education, particularly in resource-constrained settings.

Keywords

Micro science kits, practical skills development, Biology education, action research, qualitative research

Contents

CHAPTER 1: INTRODUCTION

1.0 Introduction

Micro science approach is a new and highly innovative practical science concept that uses very small scale or micro scale apparatus and chemicals. This study seeks to assess the benefits of micro science kits on practical skills development in biology students. As such, this chapter focuses on background to the study, the statement of the problem, research aims and the limitation and delimitation of the study as well as the key terms used in this study.

1.1 Background to the study

Worldwide, it has been recognized that science education is indispensable and should be effectively taught in schools (Bradley, 2018). Nowadays, the forerunner of teaching and learning science concepts is practice-based education. Studies have shown that this mode of instructional delivery equips students with practical skills through learning by doing, which promotes their knowledge, skill acquisition and performance (Twahirwa and Twizeyimana, 2020).

In line with the above background, Ministry of Primary and Secondary Education if Zimbabwe included practical work to Zimbabwe's lower and upper high school biology curriculum. In light of this, Zimbabwean, the Ministry of Education Circular No. 6 of 2001 stipulates that an Ordinary Level Biology timetable should have at least two theory periods and four practical periods per week. The Science, Innovation and Technology Policy (2012) states that practical experiments should exploit the background experiences of students and encourage interest across gender, science subjects should be taught in a way that permits every student to undertake direct practical experimentation frequently. Nevertheless, most learners countrywide have continued to perform poorly in Biology Paper 4, which is a practical examination paper as compared to Paper 1 and 2, which are theory examination papers (ZIMSEC Examiners Reports, 2024).

Practical skills development is a critical component of biology education, as it equips students with the ability to conduct experiments, make observations, and analyze data, which are essential for understanding biological concepts and processes (Bradley 2019). However, many schools in Zimbabwe, particularly in resource-limited settings, face significant challenges in providing adequate laboratory facilities and equipment for practical science lessons. These limitations often hinder students' ability to gain hands-on experience, which is crucial for effective learning (Hofstein & Lunetta, 2004). Inadequate development of these skills may hinder students' ability to design experiments, interpret results, and draw meaningful conclusions from their practical work experiences. As a result, students may struggle to fully grasp the practical applications of theoretical concepts, leading to the suboptimal academic performance in Biology practical assessments (Kusuma and Rusmansyah, 2021).

Biology is a natural science that deals with the study of living organisms (MOE Press, 2010). The importance of biology is very necessary in education because it improves the quality of life and advances countries' technological abilities through scientific research, the development of new tools and techniques, and dealing with environmental issues (Kusuma and Rusmansyah, 2021). Biology is one of the key requirements in several fields, including health care, biotechnology, bio-informatics, and agriculture (Tuyishine and Tukahabwa, 2022). Hence, any interference with the students' performance in biology must be dealt with so that the difficulties students' exhibit in biology assessment can be resolved. As a result, there is a growing need to explore alternative approaches that can provide students with practical science experiences, even in the absence of fully equipped laboratories.

Micro science kits have emerged as an innovative solution to address these challenges. These kits are compact, portable, and cost-effective tools designed to simulate laboratory experiments on a

smaller scale. They allow students to perform practical activities with minimal resources, making them particularly useful in schools with limited access to traditional laboratory infrastructure (Tuyishime and Tukahabwa, 2022). By offering a hands-on approach to learning, micro science kits have the potential to enhance students' engagement and improve their understanding of biological concepts through experiential learning.

Several studies have highlighted the benefits of micro science kits in science education. For instance, research by Charkins *et al.,* (2017) demonstrated that students using micro kits showed significant improvements in their problem-solving and analytical skills. Similarly, a study by Mumba et al. (2018) found that micro kits not only increased students' interest in science but also fostered the development of practical skills comparable to those gained through traditional laboratory experiments. These findings underscore the potential of micro science kits to bridge the gap in practical science education, especially in under-resourced schools.

Despite these promising findings, there is limited research specifically focusing on the use of micro science kits in the development of practical skills among biology students at Matsine Rural Secondary School in Hwedza district of Mashonaland East province of Zimbabwe. Given the critical role of practical skills in biology education, it is important to assess the extent to which micro science kits can substitute or complement traditional laboratories in fostering these skills. This study, therefore, seeks to evaluate the benefits of micro science kits in developing practical skills among biology students, with a focus on their effectiveness, accessibility, and impact on learning outcomes.

1.2 Problem statement

Despite the importance of practical skills in biology education, many students struggle to develop these skills due to limited hands on experience and inadequate resources. Traditional laboratory equipment and materials can be expensive ,fragile and difficult to manage ,restricting opportunities for students to engage in experiential learning .Micro science kits, which are compact ,affordable and easy to use ,have emerged as a potential solution to enhance practical skills development in biology students. However, the effectiveness of these kits in promoting hands on learning and improving practical skills in biology students remains unclear.

1.3 Research Objectives

The objectives of the research seeks to:

1. To investigate the effectiveness of micro science kits in enhancing practical skills development in biology students.
2. To identify the specific skills or competencies improved by micro science kits in biology education.
3. To evaluate the impact of micro science kits on student engagement, motivation, and attitudes towards practical work in biology.

1.4 Research questions

1. To what extent do micro science kits enhance the development of practical skills in biology students?
2. Which specific practical skills or competencies in biology are improved with micro science kits?
3. How do micro science kits influence biology students' engagement, motivation and attitudes towards practical work?

1.5 Significance of the study

The study is significant for several reasons

The study's findings will contribute to the development of more effective science education strategies, particularly in biology by highlighting the benefits of micro science kits in promoting practical skills development. More so, by investigating the impact of micro science kits on student engagement and motivation, this study will provide insights into how to increase students' interest and participation in biology practical work. To add on, results of the study will inform curriculum developers and educators about the effectiveness of micro science kits in achieving learning objectives in biology ultimately enhancing the quality of science education. Furthermore, micro science kits offer a cost effective and accessible solution for biology practical work, making this study relevant for schools and educational institutions facing resources constraints. Finally, this study will add to the existing body of research on science education practical skills development and the effectiveness of micro science kits, providing a foundation for future studies and investigations.

1.6 Assumptions of the study

It was assumed that:

- Students have basic knowledge and understanding of biology concepts and have some experience with practical work in biology.
- Micro science kits are available and accessible to students and teachers and that they are in good working conditions.
- Teachers are familiar with micro science kits and have the necessary training and support to effectively integrate them into their teaching practices.

- Students are willing to participate in practical work using micro science kits and they will engage with the activities in a constructive and meaningful way.
- The data collection tools in the study are reliable and valid, and they will provide accurate and meaningful data.

1.7 Limitations of the study

The study assessing the benefits of micro science kits on practical skills development in biology students has several limitations. One of the major limitations is the small sample size, which can affect the generalizability of the findings to a larger population. Additionally, the study may be conducted over a short period, limiting the ability to capture long-term benefits or effects of using micro science kits. The study is also limited to a specific educational setting or context, which can limit the applicability of the findings to other settings or contexts. Furthermore, the effectiveness of micro science kits may depend on the teacher ability to implement them effectively, which can be a variable that is difficult to control. The study may also rely on limited measurement tools, such as survey questionnaires or observations, which can provide only a partial picture of the benefits of micro science kits. Moreover, the study may be subject to biases, such as selection bias or confirmation bias, which can affect the validity of the findings.

1.8 Delimitation of the study

The scope of this study is deliberately limited to assess the benefits of micro science kits on practical skills development in biology students. The delimitations of the study are as follows: The study focuses exclusively on biology students, excluding students from other science disciplines. Additionally the study only examines the use of micro science kits, excluding other types of science kits or equipment. The study targets a specific age group of students. Lastly, the study takes place in a controlled environment, such as a classroom or laboratory, excluding outdoor or

informal learning settings. The study was conducted out in Wedza district focusing only on Matsine Rural Secondary school.

1.9 Definition of terms

Micro science kits (MSKs): These are educational tools designed to help students learn scientific concepts and principles through hands on experimentation and investigation. These kits typically include materials and equipment's for conducting experiments such as microscopes, slide and reagents.

Science: is the intellectual and practical activity encompassing the systematic study of the structure and behavior of the physical and natural world through observation and experiment (Blonder & Sakhnini, 2017).

Biology education: refers to the teaching and learning of various biological sciences ,encompassing various aspects of life and living organisms. (Bennett and Dunne, 1992)

Practical Skills development. Refer to acquisition of the abilities and knowledge necessary to perform specific tasks or functions in hands on manner (Blonder & Sakhnini, 2017).

1.10 Summary

This chapter highlighted the historical background of the research study, the problem statement, research objectives, research questions and hypothesis. Justification of the research study was done particularly the fact that the research may influence policy. The limitations and delimitations were discussed and key terms used in this study were defined. The following chapter reviews literature related to the impacts of integrated micro science kits on practical skills in science subjects at secondary schools.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

In the previous chapter, the problem under investigation was outlined, along with the research questions and the aims of the study. Emphasis was on the background to the problem, the rationale for the study, the questions to be answered after the study and the purposes of the study. In this chapter, the literature related to the problem investigated was reviewed. The emphasis is on the impacts of integrated micro science kits on practical skills in science subjects at secondary schools.

2.1.0 Theoretical framework of the study

The theoretical framework for this study was grounded in constructivist and experiential learning theories.

2.1.1Constructivist theory

Constructivist theory posits that learners construct their own knowledge and understanding through active engagement with their environment (Piaget, 1954). In the context of biology education, constructivist theory suggests that students learn best when they are actively involved in hands-on experiences that allow them to explore and discover scientific concepts. According to this theory, micro science kits provide learners with hands on experience and experimentation, allowing them to construct their own knowledge and understanding of scientific concepts. Micro science kits promote active learning, encouraging learners to ask questions, make observations and draw conclusions based on their experiences. Lastly micro science kits can be useful in promoting inquiry based learning, encouraging learners to ask questions ,design experiments and collect data to answer their questions.

2.1.2 Experiential learning theory

Experiential learning theory, as proposed by Kolb (1984), emphasizes the importance of direct experience in learning. According to this theory, learners progress through a cycle of concrete experience, reflective observation, abstract conceptualization, and active experimentation. Micro science kits, with their hands-on and interactive nature, can facilitate this experiential learning cycle.

2.2 Practical skills development framework

A practical skills development framework, adapted from the work of Bennett and Dunne (1992), can be used to understand the development of practical skills in biology students. This framework identifies three stages of practical skills development:

1. Basic skills: Students develop basic laboratory skills, such as measurement and observation.

2. Procedural skills: Students learn to follow established procedures and protocols.

3. Investigative skills: Students develop the ability to design and conduct their own investigations

2.3 The characteristics of micro science kits

Micro science kits are innovative educational tools designed to provide hands-on learning experiences for students. According to research, these kits typically possess several key characteristics that make them effective for science education (Hofstein & Lunetta, 2004). They are usually portable, affordable, and easy to use, allowing students to conduct experiments and investigations in a variety of settings (Blonder & Sakhnini, 2017).

Micro science kits often focus on specific scientific concepts or topics, such as chemistry, physics, or biology, and include materials and equipment necessary for students to explore these concepts (Abrahams & Millar, 2008). They may also incorporate technology, such as microscopes or sensors, to enhance data collection and analysis (National Research Council, 2012). For example, studies have shown that the use of micro science kits can improve students' understanding of scientific concepts, such as photosynthesis and respiration (Lin *et al*., 2013).

Another important characteristic of micro science kits is their ability to promote inquiry-based learning, encouraging students to ask questions, design experiments, and think critically about scientific phenomena (Bybee, 2006). By providing students with hands-on experiences and opportunities for exploration, micro science kits can help develop essential skills in scientific literacy, problem solving, and collaboration (Osborne & Dillon, 2008).

2.4 Effectiveness of micro science kits in enhancing practical skills in Biology

The application of microscale science kits in education has gained significant attention due to their potential to make scientific experiments more cost-effective, accessible, and engaging. In biology education, practical skills are a crucial component, and the use of these kits has been explored as a solution to challenges such as lack of laboratory resources, safety concerns, and logistical barriers in traditional laboratory setups.

Micro science kits are designed to simplify and miniaturize laboratory experiments, enabling students to perform hands-on activities with minimal resources. These kits typically include scaled-down versions of laboratory apparatus and materials, making them affordable and portable. Recent studies have shown that these kits can positively influence students' engagement, understanding of biological concepts, and acquisition of practical skills.

2.4.1 Improved accessibility and engagement

Studies highlight that micro science kits improve accessibility to practical experiments, especially in resource-limited settings. For instance, Okeke & Nwosu (2022) found that micro kits helped bridge the gap between theory and practice by allowing students in rural schools to conduct experiments that would otherwise require expensive equipment. This finding agrees with the studies by Dagnew & Sitotaw and Kambaila & Kayamba that utilising practical activity significantly enhances students' academic performance in Biology (Dagnew and Sitotaw, 2019).The portability of these kits also makes them suitable for use in classrooms without dedicated laboratory spaces.

2.4.2 Development of practical skills

According to Akinbobola & Afolabi (2023), students using micro science kits demonstrated significant improvements in practical skills such as observation, measurement, and experimental design. This study emphasized that the hands-on nature of these kits fosters critical thinking and

problem solving, which are essential for biology students. According to Smith and Lim (2024) they argued that the use of micro science kits help biology students construct their knowledge, develop logical and inquiry type skills and develop psychomotor skills.

2.4.3 Cost effectiveness and sustainability

A key advantage of micro science kits is their affordability compared to traditional laboratory setups. The work of Chinyere *et al*. (2021) shows that these kits reduce the cost of consumables and equipment while maintaining the quality of experiments. This cost-effectiveness allows schools with limited budgets to enhance their biology practical programs without compromising educational outcomes. Acquisition of laboratories is expensive and so acquiring micro science kits could provide the same enabling environments (Tantayanon 2016). Studies by Abrahams and Williams (2008) argues that by reducing cost ,micro science kits can increase access to science education for poor rural schools and students with limited resources.

2.4.4 Safety and environmental benefits

Micro science kits reduce the volume of chemicals and biological materials used, minimizing risks and environmental impact. Sharma *et al.* (2023) reported that students felt more confident performing experiments with reduced safety concerns, leading to increased participation and skill development.

Most studies on micro science kits have been conducted in urban or well-resourced schools, leaving a gap in understanding their effectiveness in rural day schools with potentially limited resources and infrastructure. More so, rural day schools like Matsine may face unique challenges such as limited access to resources, inadequate teacher training and varying student backgrounds, which can affect the effectiveness of micro science kits. These knowledge gaps highlights the need

for research that examines the effectiveness of micro science kits in enhancing practical skills development among biology students in Matsine and similar rural day schools.

2.5.0 Specific skills or competencies improved using micro science kits in Biology education.

Micro science kits, known for their portability, affordability, and simplicity, have emerged as innovative tools in biology education. They offer hands-on learning opportunities and are especially impactful in resource-limited settings. This review synthesizes recent research to identify specific skills and competencies enhanced by the use of micro science kits in biology education. Research highlights that micro science kits enhance a variety of practical, cognitive, and interpersonal skills critical for biology students. These competencies fall into three main categories:

2.5.1. Practical and technical skills

2.5.2 Observation skills

Micro science kits improve students' ability to observe biological processes and phenomena. Okeke & Nwosu (2022) reported that students using these kits demonstrated greater attention to detail, as the kits often require careful examination of microscopic or small-scale features, such as cell structures or enzyme reactions. Musa & Oladele (2022) observed that students developed competencies in recording observations, interpreting results, and forming evidence-based conclusions.

2.5.2 Measurement and precision

The use of micro kits develops students' accuracy in measurement. Sharma *et al*.,(2023) found that students learned to handle micropipettes, capillary tubes, and other scaled-down instruments with precision, fostering dexterity and fine motor coordination. In the same vein, Zhang *et al* (2018)

suggest that micro science experiments improved students' accuracy in measurement and observation, leading to better scientific literacy.

2.5.3 Experimental design and execution

Micro science kits encourage students to set up and conduct experiments independently. Chinyere *et al* (2021) emphasized that the kits enable students to systematically follow scientific protocols, manage variables, and troubleshoot errors, fostering independence and experimental skills. Furthermore ,the studies by Bencze & Hodson (1999) supports the results as they also noted that micro science kits improved students practical skills ,including laboratory techniques and scientific inquiry.

2.5.4 Laboratory safety

The reduced use of hazardous chemicals and biological materials in micro kits minimizes risks, allowing students to learn and practice proper laboratory safety protocols. Akinbobola & Afolabi (2023) noted that students gained confidence in handling materials safely.

2.6.0 Cognitive and analytical Skills

2.6.1Critical Thinking

The inquiry-based nature of micro science kits promotes critical thinking. According to Adams & Karanja (2023), students are encouraged to ask questions, hypothesize, and analyze results, which enhances their problem-solving abilities and scientific reasoning.

2.6.2 Data collection and interpretation

Micro kits often include tools for collecting and analyzing data, such as measuring pH levels or observing growth patterns. Musa & Oladele (2022) observed that students developed competencies in recording observations, interpreting results, and forming evidence-based conclusions.

2.6.3 Conceptual understanding

Hands-on activities with micro kits improve students' grasp of biological concepts. Okonkwo *et al*., (2021) found that students demonstrated a deeper understanding of topics such as osmosis, photosynthesis, and cell division after using micro kits, as these experiments bridged the gap between theoretical knowledge and practical application. Studies have shown that students using micro science kits demonstrate significant improvements in practical skills (Akinbobola & Afolabi, 2023) and feel more confident performing experiments with reduced safety concerns, leading to increased participation and skill development (Sharma *et al*., 2023). To add on, Bradley (200) who reported that there were satisfactory knowledge gains accompanying practical work that was carried out in the study using micro science kits as an alternative approach in science practical work in South Africa.

2.7.0 Communication and Collaboration Skills

2.7.1 Teamwork

Micro kits are often used in-group settings, promoting collaboration among students. Sharma et al. (2023) noted that students learned to divide tasks, share findings, and work cohesively in teams during experiments.

2.7.2 Scientific communication

Writing lab reports and presenting findings are integral to using micro kits. Afolabi *et al*., (2023) reported that students improved their ability to document experimental procedures, analyze results, and present conclusions clearly and concisely. In a separate study by Dagnew & Sitotaw , (2019) who highlight the importance of collaborative learning in developing social and communication skills.

There is a notable knowledge gap in understanding the specific or competencies that micro science kits improve among biology students in rural day schools like Matsine. It is unclear which specific

practical skills such as experimentation, observation, measurement or data analysis, are most enhanced by micro science kits in the context of Matsine and similar rural day schools. More so, the rural setting and potential resource constraints of Matsine may influence which skills or competencies are most developed through the use of micro science kits, but this has not been thoroughly investigated.

2.8 Impacts of micro science kits on student engagement, motivation, and attitudes toward practical Biology work.

Student engagement, motivation, and positive attitudes toward science are critical factors for effective learning, especially in practical subjects like biology. Micro science kits (MSKs), known for their cost-effectiveness, portability, and hands-on approach, have been introduced to address challenges in traditional laboratory setups. This review evaluates the impact of MSKs on these aspects of student learning, supported by recent empirical studies and relevant citations.

2.8.1 Impact on student engagement

Engagement in biology practicals is often hindered by limited resources, logistical challenges, and traditional teaching methods. Micro science kits provide an accessible and interactive platform that enhances student participation.

2.8.1.2 Increased participation

According to Okeke and Nwosu (2022), students using MSKs showed higher levels of participation in practical activities compared to those in traditional laboratory settings. The ease of use and simplified processes encouraged even less confident students to actively engage in experiments.

2.8.1.3 Interactive learning

Sharma et al. (2023) found that the hands-on nature of MSKs fostered interactive learning, as students could directly manipulate materials and observe outcomes, making the learning process more immersive and engaging.

2.8.1.4Time efficiency

The compact design of MSKs allows for quicker experiment setups, enabling students to focus more on the learning process rather than logistical challenges. Chinyere *et al*., (2021) highlighted that this efficiency positively influenced students' sustained engagement throughout the lessons.

2.9.0 Impact on student motivation

Motivation plays a crucial role in science education, and MSKs have been shown to stimulate students' interest and enthusiasm for biology.

2.9.1 Intrinsic motivation

Afolabi and Akinbobola (2023) reported that students using MSKs exhibited increased intrinsic motivation, as the kits allowed them to perform experiments independently, fostering a sense of ownership over their learning. In a separate research by Deci and Ryan (2000), highlights the importance of autonomy support and hands-on learning in promoting intrinsic motivation

2.9.2 Relevance to real-life applications

Micro science kits provide simplified yet relatable experiments that connect theoretical concepts to real-world applications. Adams and Karanja (2023) found that this relevance boosted students' motivation to learn biology, as they could see the practical implications of their work. In a separate work by Hmelo-Silver (2004), emphasized the importance of hands-on, inquiry-based learning in promoting student engagement and motivation.

2.9.3 Overcoming resource barriers

In resource-limited schools, MSKs bridge the gap by providing affordable alternatives to traditional lab equipment. Musa and Oladele (2022) noted that students in underprivileged settings felt empowered to engage in practical biology, which previously seemed inaccessible due to resource constraints.

2.10 Impact on students' attitudes towards practical Biology

Positive attitudes toward practical work in biology are essential for fostering long-term interest in the subject. MSKs have been shown to improve students' perceptions of biology practicals.

2.10.1 Reduction in fear and anxiety

Traditional biology labs can be intimidating for some students due to the complexity of equipment and procedures. Okonkwo *et al*.,(2021) observed that MSKs reduced fear and anxiety by simplifying experiments, making students more confident and willing to participate.

2.10.2 Perceived usefulness

Sharma *et al*.,(2023) found that students viewed MSKs as valuable tools for learning biology, which improved their overall attitude toward the subject. This perception was particularly strong when students could directly see the results of their experiments.

2.10.3 Fostering curiosity

MSKs encourage students to ask questions and explore biological phenomena, fostering a sense of curiosity. Chinyere et al. (2021) highlighted that students became more inquisitive and willing to explore beyond the prescribed curriculum after using MSKs. A research by Osborne and Dillon (2008), emphasize the importance of practical work in developing positive attitudes towards science.

There is a significant knowledge gap in understanding the impact of micro science kits on student engagement, motivation, and attitudes towards practical work in biology among students in rural day schools like Matsine. It is unclear how micro science kits influence student engagement and participation in practical activities in the context of Matsine, where students may have limited exposure to hangs on science experiences. More so, there is limited research on how micro science kits affects students' attitudes towards biology and practical work in rural settings, including their confidence, enjoyment and perceived relevance of the subject.

2.11 Summary

This chapter has reviewed literature related to the problem investigated in this study that is, the merits of teaching and learning of science using the micro-sciences kit in secondary schools. The information gathered in this literature review was used as the theoretical framework to judge the data collected from the field (Chapter 4 and Chapter 5). From that perspective, conclusions will be drawn in order to verify the extent to which the objectives were achieved and to find the answers sought for the research questions. The next chapter highlights the research methodology used in this study, including the instruments, procedures and design used to investigate the problem of the study.

CHAPTER THREE: RESEARCH METHODOLOGY

3.0 Introduction

This chapter describes the methodology used in this research. For the purpose of this study, a qualitative research method was used. In this chapter, the research methodology discussed encompasses the research design, geographical location of the area, population and sampling procedures, research instruments used for data collection, research ethics, data collection approaches as well as data presentation and analysis.

3.1 Research Design

Research design as a plan for study, outlining the overall framework for collecting data. (Polit and Hungler, 2004). In this research of assessing the benefits of micro science kits on practical skills development in biology students, the methods that were used were qualitative in nature. The study employed an action research design, which describes the process of systematic inquiry that studies a school situation to understand and improve the quality of the educational process (Abdullah *et al.*, 2005).

Three practical lessons, named Cycle A, Cycle B, and Cycle C, each represented by a weekly intervention, were used to perform the research. Each cycle of research process, as stated by Clarke, involved planning, acting, observing, and reflecting to continuously improve the effectiveness of practical work in enhancing academic students' performance, and the acquisition of scientific process skills in Biology (Clarke 2023). Thus, this design was appropriate to help assess the impacts of using micro science kits in the teaching and learning of selected concepts in students' performance in the study of Biology. The research design made use of practical work in teaching Biology as an intervention. Practical work on microscopy and cell biology were conducted in data gathering process. A sample of biology students were randomly assigned to either experimental group or a control group. A random sampling was done to eliminate bias in grouping students to

into groups. The experimental group will use micro science kits to conduct practical activities, while the control group will use traditional teaching methods.

3.2 Population of the study

According to Polit and Hungler, (2004), a population refers to a group of individuals sharing common characteristics of interest to the researcher. In this study, the population comprised all Form 3 Science students studying Biology and Biology teachers at Matsine Secondary School within the Wedza district in Mashonaland East, Zimbabwe. The Form 3 Science class consisted of 50 students, with 32 females and 18 males. This group was chosen because they had attended the school for over two years, gaining exposure to basic scientific process skills. Including Biology teachers in the study provided a broader perspective, enabling a more comprehensive understanding of the research issue. This population served as the basis for drawing a working sample, allowing the researcher to investigate the effectiveness of micro science kits in enhancing learners' engagement and attitudes towards practical work in Biology.

3.2 Sample and Sampling technique

According to Leedy (2006), a sample is a group of respondents that represents the population being studied, possessing typical attributes of that population. In this study, a convenience sampling technique was employed to select a Form 3 Science class, comprising 16 students, to serve as the sample. This technique allows researchers to select samples from those with whom they have easy access (Larsen, 2018), making it a feasible approach for this research.

The selected sample consisted of students aged between 14 and 18, with diverse cultural backgrounds. The group comprised 9 males and 7 females, providing a range of perspectives. Additionally, 3 Science teachers from the same station were included in the data gathering process,

bringing the total number of participants to 19. This sample size was deemed sufficient to provide reliable and valid outcomes that could be generalized.

The students were randomly assigned to either an experimental group (n=8) or a control group (n=8). Notably, prior to the study, the participants had been exposed to lecture-based teaching methods, revealing a deficiency in student-centered instructional strategies and inadequate practical work sessions. The manageable group size facilitated effective data extraction and analysis, allowing for an in-depth examination of the impact of micro science kits on learners' engagement and attitudes towards practical work in Biology.

3.3.0 Research instruments

Research instruments are tools used to collect, measure, and analyze data related to a study. In this research, the researcher utilized a combination of questionnaires, interviews, and direct observation as data collection tools. These methods were chosen for their efficiency, simplicity, and ability to save time in data collection, making them well suited for this study (Larsen, 2018). By employing these research instruments, the researcher was able to gather comprehensive data on learners' attitudes, perceptions, and experiences with micro science kits, providing a rich understanding of their effectiveness in enhancing science education.

3.3.1 Questionnaire guide for learners.

According to Larsen (2018), a questionnaire is a document containing a list of questions designed to gather facts for a survey. In this study, a questionnaire was administered to students (Appendix 3) to collect data on their attitudes towards practical work and their perceptions of the effectiveness of micro science kits. The student questionnaire was divided into sections, comprising Likert scale questions, open-ended questions, and closed-ended questions, totaling 20 items.

The Likert scale questions were used to capture quantitative data on students' attitudes and perceptions, while open-ended questions gathered qualitative insights into the benefits and challenges of micro science kits. The use of a Likert scale made it easier to capture and analyze the data, and triangulation benefit to the qualitative data. The questionnaire was administered after lunchtime, but before dismissal, allowing students sufficient time to respond without feeling rushed. On average, each learner took approximately 20-25 minutes to complete all sections.

The main advantage of using a questionnaire in this study was the ability to collect data from a large group of students simultaneously, within a short period. This approach enabled efficient data collection, facilitating the gathering of both quantitative and qualitative data, and providing a comprehensive understanding of students' experiences with micro science kits. By using a questionnaire, the researcher was able to collect rich, detailed data that shed light on the effectiveness of micro science kits in enhancing students' learning experiences.

3.3.2 Interview Guide for learners and teachers

This study utilized semi-structured interviews to gather in-depth insights into the impact of Micro science kits on student engagement, motivation, and attitudes towards practical work in Biology. Drawing from Leedy (2006) definition of an interview as a questionnaire administered by an interviewer, this research adapted a flexible approach to capture detailed learner opinions. Student interviews focused on evaluating the impact of Micro science kits, gathering data on engagement, motivation, and attitudes towards practical Biology work, as outlined in Appendix 1.

The semi-structured format allowed for open-ended discussions, enabling students to share their experiences and perceptions of benefits and challenges associated with Micro science kits (Larsen, 2018). These interviews were conducted on weekends to provide ample time for learners to express

their views without constraint. Both handwritten notes and audio recordings using a cellphone ensured comprehensive data capture.

In addition to student interviews, teachers were also interviewed to gather expert insights and validate the findings. The teacher interview guide covered all research objectives, as shown in Appendix 2, and was designed to gain in-depth insights into the objectives from the teachers' contextual understanding and expertise. Teachers' interviews offered a nuanced understanding of Micro science kits' effectiveness, highlighting their potential benefits in enhancing Biology education.

By incorporating both learner and teacher perspectives, this study gained a comprehensive understanding of the impact of Micro science kits, providing valuable insights for educational practice and future research.

3.3.3 Direct observation checklist guide

Direct observation is a research method that involves systematically observing and recording behavior, events, or phenomena in a natural or controlled setting (Hanson and Sakina 2014). This approach allows researchers to collect data on actual behaviors, rather than relying on self-reported information. The direct observation guide is shown on the appendix 5.The advantages of direct observation include the collection of rich, detailed data on behavior, insight into the context in which behaviors occur, and the provision of objective data.

However, one limitation of direct observation is that the presence of an observer can potentially influence participant behavior. Despite this limitation, direct observation was used in this study to examine learners' activities during three practical lessons where they used micro science kits. The researcher recorded detailed notes on the skills acquired by learners during these sessions, enabling

the collection of rich, contextual data on learners' behaviors and experiences with micro science kits.

By using direct observation, this study aimed to gain a deeper understanding of how micro science kits influences learner engagement, motivation, and attitudes towards practical work in Biology. The detailed notes generated during the observation sessions will provide valuable insights into the benefits associated with using micro science kits in the classroom, contributing to a more comprehensive understanding of their effectiveness in enhancing science education.

3.4 Data collection procedures

The data collection process began with obtaining permission from the Ministry of Primary and Secondary Education, Wedza district office, which was granted after a formal application (Appendix 4). Following this approval, the researcher contacted the authorities at Matsine Secondary School, briefed them on the subject matter, and scheduled interviews and questionnaire administration.

To ensure the reliability of the research instruments, a pilot test was conducted at Gumbonzvanda Secondary School, a school sharing similarities with the study school and located in the same district. The experimental group then participated in practical lessons using micro science kits, focusing on microscopy and cell biology concepts, over three consecutive lessons in a span of three weeks.

3.4.1 Interview sessions

As a researcher,I utilized an interview guide to gather in depth ,qualitative data from teachers and students at Matsine secondary school on the impact of micro science kits on teaching and learning biology. The guide was crafted to include open-ended questions that would encourage participants to share their experiences, perceptions and insights.

Before conducting the interviews, I pilot tested the guide with a small group of teachers and students as explained above, to ensure that the questions were clear, relevant and effective in eliciting the desired information. This process allowed the researcher to refine the guide and make necessary adjustments.

The interviews, with the three (3) teachers were conducted over the phone, allowing for flexibility and convenience given their busy schedules. Each teacher interview lasted approximately 30-45 minutes, with an average duration of 38 minutes. In contrast, eight (8) student interviews were conducted in person at Matsine secondary school during weekends, when students were more readily available. Each student interview lasted approximately 30-40 minutes, with an average duration of 32minutes.

During the interview, I established rapport with the participants, creating a comfortable and non-threatening environment that encouraged them to share their thoughts and feelings openly. With participants' consent, l recorded the interviews using a phone, which allowed me to capture the conversation verbatim. Additionally, I took notes during the interviews to highlight key points and observe any notable nonverbal cues.

The interview guide included questions such as shown in appendices 1 and 2. The questions helped in gathering enough details from both students and teachers.

After the interview, I transcribed the recordings verbatim ensuring that the data was accurately captures. I then analyzed the transcripts, identifying several themes and patterns that emerged from the participants' responses.

3.4.2 Questionnaire administration

Administering was a questionnaire is a crucial step in gathering data from students to assess the benefits of micro science kits in enhancing practical skills development in biology at Matsine Secondary School. The questionnaire was administered to 8 students during afternoon free periods, when they were more readily available and focused. The questionnaire consisted of 20 items, including questions about the benefits of using micro science kits, such as enhanced practical skills development, increased engagement, and improved understanding of biological concepts.

The students were given sufficient time to complete the questionnaire without feeling rushed, and their responses were kept confidential to encourage honest and open feedback. The average time taken by participants to complete the questionnaire was approximately 20-25 minutes. After completing the questionnaire, the researcher collected all the responses from the 8 students and reviewed them for completeness and accuracy.

All responses were collected, and none of the participants had any issues or difficulties in completing the questionnaire. The responses were then categorized to identify patterns and themes in the data. The questionnaire focused on the benefits of micro science kits, including practical skills development, such as observation, measurement, and experimentation, as well as student engagement and understanding of biological concepts. Open-ended questions allowed students to provide detailed, qualitative responses about their experiences with micro science kits.

3.4.3 Direct observation process

During practical lessons, the researcher used an observation guide to gather data on students' use of micro science kits in biology classes at Matsine Secondary School. The observation guide was designed to capture specific aspects of students' behavior and interactions with the micro science kits, including their ability to follow instructions and use the kits correctly, engagement and

participation during practical activities, ability to observe, measure, and record data accurately, collaboration and communication with peers during group work, and ability to analyze and interpret data.

The researcher observed students during practical lessons, using the observation guide to record notes and observations in a systematic and thorough manner. The data was recorded through handwritten notes, ticking off specific criteria on the observation guide, and noting down descriptive details about students' behavior and interactions. The researcher took note of students' behavior, interactions, and use of the micro science kits, observing how they worked together in groups, asked questions, and sought help when needed.

The observation guide helped the researcher to focus on specific aspects of students' behavior and interactions, ensuring that the data collected was relevant and useful for the study. By using the observation guide, the researcher was able to gather rich, qualitative data on students' experiences with micro science kits, providing valuable insights into their effectiveness in enhancing practical skills development in biology.

3.5 Data Presentation and Analysis Procedures

This study employed a qualitative data analysis approach, guided by the principles outlined by Creswell (1998), who define data analysis as a process of inspecting, cleaning, transforming, and modeling data to highlight useful information and support decision-making. The qualitative nature of the research allowed for an in-depth exploration of the data, with a focus on identifying themes and sub-themes that emerged from the respondents' experiences and perspectives.

The data analysis process involved recording and organizing the data, followed by a thorough examination to identify patterns and commonalities that satisfied each research objective. The

themes that emerged from the data were developed based on the respondents' views on the benefits of micro science kits, and these themes were carefully linked to the literature review to ensure that the findings were grounded in existing knowledge and research.

The findings were presented in a way that provides a clear understanding of how micro science kits influences student engagement, motivation, and attitudes towards practical work in Biology. By analyzing the data in a systematic and rigorous manner, this study aims to contribute to the existing body of knowledge on the use of micro science kits in education and provide valuable insights for educators, policymakers, and researchers. The presentation of the findings were structured around the themes and sub-themes that emerged from the data, with supporting evidence from the respondents' quotes and observations.

3.6 Ethical consideration

In this research study, fundamental ethical principals were applied. Punch (2005), defines research ethics are moral obligations and principles that researchers should adhere to in carrying out and reporting their studies. Denzin and Lincoln (1998), stresses out that research ethics are important in that they enable the researcher to develop meaningfully acceptable research protocols that are worth the participants' time and have a reasonable chance of yielding meaningful findings, protects the rights of participants' and report results fairly and accurately. In respect of this, the researcher obtained a written authorization will be obtained from all relevant authorities such as the Ministry of Primary and Secondary Education and the schools administrations and also sought for written consent from participants before gathering data. The researcher informed all participants on the purpose, benefits and possible risks of their involvement in the research study in order to ensure voluntary participation. Participants will be free to withdraw from the study at any time.

3.7 Validity and Reliability

Reliability is defined as the accuracy of the actual measuring instrument or procedure, while validity is the appropriateness, meaningfulness, and usefulness of specific inferences made from the answer (Leedy, 2006). In other words, validity is concerned with the study's success at measuring what the researcher set out to measure. To ensure that the research study is valid and reliable, the researcher used both qualitative and quantitative research methods so that they complement each other's weaknesses. The instruments were field-pilot tested at Gumbonzvanda Secondary School, which shares many similarities with the study school and is located in Wedza district, in order to determine reliability.

3.8 Summary

This chapter looked at the research methodology used in the study to assess the benefits of micro science kits on practical skills development in biology students. In particular, the chapter hammered on research design, population, sample and sampling procedure. Research instruments used in the study include interviews; questionnaire and direct observations were used to gain valid and reliable insight of the study. The procedure for collecting data, validity and reliability, data presentation and analysis procedure as well as ethical considerations were fully discussed. In the next chapter, data presentation, analysis and discussion will be dealt with.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter presents analysis and discussion of qualitative data collected from Matsine Secondary School in Wedza district. The study explores the benefits of micro science kits on practical skills development in biology students. Data was generated through interviews, direct observation and questionnaires. The findings will be linked to the related literature, and the discussion will focus on addressing the research questions and objectives.

4.1 Effectiveness of Micro Science Kits in Enhancing Practical Skills in Biology

From students' activities and responses as well as the teachers' responses, it became clear that micro science kits are influential in enhancing practical skills in biology as evidenced by the themes discussed below**.**

4.1.1Theme 1: Accessibility and engagement

Students reported that the kits provided hands-on experiences, enhancing their engagement and motivation to learn. One student noted, "*I enjoyed using the microscopes and biological slides; it helped me understand biological concepts better*" (Student 1). This hands-on approach significantly improved students' practical skills, including handling laboratory equipment, conducting experiments, and following procedures. The micro science kits provided students with hands-on opportunities to practice core biological techniques in a controlled and accessible manner. Unlike traditional methods, the kits allowed students to work independently or in small groups, fostering confidence and deeper understanding. As one student highlighted, "*I loved conducting experiments with the kits. It made biology more interesting*" (Student 4). This increased participation, Okeke, and Nwosu (2022), who found that students using micro science kits showed higher levels of participation in practical activities compared to those in traditional laboratory settings, support engagement. This finding agrees with the studies by Dagnew & Sitotaw and

Kambaila & Kayamba that utilising practical activity significantly enhances students' academic performance in Biology (Dagnew and Sitotaw, 2019). The study conforms with Zhang *et al* (2018) who found out that student who used the micro science kits reported higher levels of engagement and motivation compared to traditional teaching methods.

4.1.2 Theme 2: Development of practical skills

Teachers also observed that micro science kits were instrumental in developing essential practical skills, such as observation, measurement, and experimentation. As one teacher highlighted, "*The kits have been instrumental in helping students develop essential practical skills, such as observation, measurement, and experimentation*" (Teacher 1). Direct observations confirmed that students demonstrated key skills, including observation, measurement, and data recording. Another student emphasized the importance of safety and accuracy, stating, "*The kits taught me how to conduct experiments safely and accurately" (*Student 2). This finding is in agreement with the results of the study by Apeadido (2024). He observed that at the conclusion of the intervention with micro science kits, the majority of students demonstrated the appropriate skills required for the practical task, indicating that they had mastered the process skills necessary to flourish in their learning of Biology. The findings conform to the results by Zhang *et al* (2018) who noted that students who used the micro science kits showed significant improvement in their practical skills, including measurement, observation and data analysis, support the research results. In the same vein research has also shown that hands on activities such as those facilitated by micro science kits, are essential for developing practical skills in science education (Osborne , 2014).

4.1.3 Theme 3: Enhanced understanding of biological concepts

Micro science kits facilitated a deeper understanding of biological concepts ,with students showing improved proficiency in preparing biological slides and using microscopes. Teachers reported that the kits promoted scientific inquiry skills, such as questioning, hypothesizing, and problem-solving.

A teacher noted that the kits encouraged students to think critically and develop scientific inquiry skills, preparing them for more advanced scientific studies. "*The kits encourage students to think critically and develop scientific inquiry skills, preparing them for more advanced scientific studies*" (Teacher 2).

The intervention with micro science kits improved students' understanding of key biological concepts, such as cell biology. Students were able to connect theoretical knowledge to experimental outcomes, as observed through improved performance in practical sessions. As one student noted, *"Using the kits helped me visualize complex concepts, making it easier to grasp*" (Student 3). Teachers also reported that the kits helped students visualize complex concepts, making it easier for them to grasp and retain information. "*Kits help students visualize complex concepts, making it easier for them to grasp and retain information*" (Teacher 3).

These findings are supported by existing research. Studies have shown that students using micro science kits demonstrate significant improvements in practical skills (Akinbobola & Afolabi, 2023) and feel more confident performing experiments with reduced safety concerns, leading to increased participation and skill development (Sharma *et al*., 2023). To add on, the results of the study are consistent with those of Bradley (200) who reported that there were satisfactory knowledge gains accompanying practical work that was carried out in the study using micro science kits as an alternative approach in science practical work in South Africa. Overall, the use of micro science kits enhanced students' understanding of biological concepts, practical skills, and scientific inquiry abilities.

4.1.4 Theme 4: Cost effective

The kits were found to be cost-effective, minimizing the need for large-scale laboratory setups. This was particularly beneficial for schools with limited resources, as the kits required less space,

fewer consumables, and no reliance on expensive equipment. Teachers reported that the kits reduced logistical challenges, allowing for more frequent and consistent practical sessions. Another teacher emphasized the cost effectiveness of micro science kits, stating, "*Using micro science kits has been a game changer for our school. Not only are they affordable, but they also allow us to conduct experiments in a safe and controlled environment." (*Teacher 2). This is in line with Osborne (2014) who confirms that studies have shown that micro science kits can have a positive impact on students acquisition of practical skills in Physics at low cost. In support , studies by Abrahams and Williams (2008) argues that by reducing cost ,micro science kits can increase access to science education for poor rural schools and students with limited resources. Thus, by democratizing access to practical biology education, micro science kits helped bridge the gap between theory and practice, especially in under-resourced schools.

The study's findings contribute to the body of knowledge by demonstrating that micro science kits are valuable resources for enhancing science education, particularly in under-resourced rural day schools. These kits offer accessible and engaging hands-on learning experiences that can help bridge educational inequalities, address specific challenges faced by rural schools, and ultimately improve student outcomes in these context.

4.2 Specific Skills or Competencies Improved Using Micro Science Kits in Biology Education.

Research highlights that micro science kits enhance a variety of practical, cognitive, and interpersonal skills critical for biology students.

4.2.1 Theme 1: Observation and Measurement.

The use of micro science kits significantly improved students' observation and measurement skills. According to Teacher 1, *The micro science kits have significantly improved students observation*

and measurement skills ,allowing them to collect accurate data and make conclusions", Students echoed this sentiment with one noting , *"I learned how to use microscope and measure accurately ,which helped me understand cells better*" (Student 1). This finding is consistent with Musa & Oladele (2022) observed that students developed competencies in recording observations, interpreting results, and forming evidence-based conclusions. In the same vein, Zhang *et al* (2018) suggest that micro science experiments improved students' accuracy in measurement and observation, leading to better scientific literacy. By providing students with hands on experience with scientific equipment, micro science kits enabled them to develop these essential skills, leading to deeper understanding of biological concepts.

4.2.2 Theme 2: Scientific inquiry skills

The micro science kits promoted scientific inquiry skills among students. Teacher 2 observed, "*I've noticed that students are now more confident in designing experiments, hypothesizing and testing scientific theories using the kits*". Students agreed, with one stating, "*Using the kits, I developed my questioning skills and learned to design experiments to test hypothesis"*. Researchers direct observations also revealed that students were actively engaged in scientific inquiry, posing questions and exploring concepts through hands on experimentation. This finding aligns with research by Pedastel *et al* (2015) who highlighted that importance of inquiry based learning in developing scientific literacy and critical thinking skills. The study results also concur with the work done by Abrahams and Miller (2008) who argues that micro science activities improved students scientific literacy ,enabling them to think critically and make informed decisions in rural day secondary schools.

4.2.3 Theme 3: Practical skills

The micro science kits enhanced students' practical skills in biology. According to Teacher 3, *"The kits have enhanced students' practical skills, such as handling equipment, conducting experiments,*

and following scientific procedures." Students reported gaining confidence in practical work, with one noting, "*I gained confidence in handling equipment and conducting experiments, which made biology more enjoyable*" (Student 4). Researchers' direct observations revealed that students demonstrated improved proficiency in using scientific equipment and techniques. This finding is supported by research by Abrahams and Millar (2008), who emphasize the importance of practical work in developing students' scientific skills and understanding. Furthermore ,the studies by Bencze & Hodson (1999) supports the results as they also noted that micro science kits improved students practical skills ,including laboratory techniques and scientific inquiry. By providing hands-on experience, micro science kits enabled students to develop practical skills essential for scientific investigation.

4.2.4 Theme 4: Critical Thinking and Analytical Skills

The micro science kits fostered critical thinking and analytical skills among students. Teacher 4 noted, "*Students are developing critical thinking and analytical skills, interpreting data, and drawing meaningful conclusions from their experiments*." Students reported improved analytical skills, with one stating, "*The kits helped me analyze data and draw conclusions, which improved my understanding of biological concepts" (*Student 7). Researchers' direct observations revealed that students were actively engaged in analyzing data, identifying patterns, and drawing evidence-based conclusions. This finding is consistent with research by Zohar and Dori (2003), who emphasize the importance of inquiry-based learning in promoting critical thinking and analytical skills. By encouraging critical thinking and analysis, micro science kits enabled students to develop deeper understanding and scientific literacy.

4.2.5 Theme 5: Collaboration and Communication Skills

The micro science kits promoted collaboration and communication skills among students. According to Teacher 2, "*The kits promote collaboration and teamwork among students,*

encouraging them to share ideas, discuss findings, and present results effectively." Students reported improved communication skills, with one noting, "*Working in groups with the kits taught me how to share ideas, discuss findings, and present results effectively*" (Student 5). Researchers' direct observations revealed that students worked collaboratively, shared ideas, and communicated scientific concepts effectively. This finding aligns with research by Gillies and Boyle (2010), who highlight the importance of collaborative learning in developing social and communication skills. By facilitating group work and presentations, micro science kits enabled students to develop essential collaboration and communication skills.

The findings suggest that micro science kits improve various skills and competences essential for biology education, including observation, scientific inquiry, practical skills, critical skills and collaboration. Teachers' observations highlight the positive impact of micro science kits on student learning, these quotes from the teachers provide valuable insights into the benefits of micro science kits in biology education.

4.3.0 Impacts of Micro Science Kits on Student Engagement, Motivation, and Attitudes toward practical Biology Work.

4.3.1 Theme: Increased Engagement

The micro science kits significantly increased student engagement in practical biology lessons. According to Teacher 1, *"I've noticed a significant increase in student engagement and participation during practical biology lessons since introducing the micro science kits*." Students echoed this sentiment, with one noting, "*I loved using the micro science kits. It made biology more interesting and interactive"* (Student 1). Researchers' direct observations revealed that students were actively participating in experiments, asking questions, and exploring scientific concepts. This finding is consistent with research by Hmelo-Silver (2004), who emphasizes the importance

of hands-on, inquiry-based learning in promoting student engagement and motivation. The results go hand in hand with the work drawn Osborne and Dillon (2008) who observed that micro science kits accelerated the improvement of students attitudes towards biology ,leading to increased motivation and interest . More so, in the same vein, Bradley (2000) found also that the use of micro science apparatus by pre service teachers had improved their conceptual understanding and pedagogical content in Chemistry. Through the interactive and hands-on learning experiences, micro science kits enabled students to engage more deeply with biological concepts.

4.3.2Theme: Enhanced Motivation

The micro science kits enhanced student motivation in practical biology lessons. According to Teacher 2, "*The kits have motivated students to take a more active role in learning biology, and they're more enthusiastic about conducting experiments*." Students reported increased motivation, with one stating, "*Using the kits motivated me to learn more about biology and participate in class*" (Student 2). Researchers' direct observations revealed that students were more eager to participate in experiments, asked more questions, and showed a genuine interest in learning. This finding aligns with research by Deci and Ryan (2000), who highlight the importance of autonomy support and hands-on learning in promoting intrinsic motivation. The results are consistent with the work drawn Osborne and Dillon (2008) who observed that micro science kits accelerated the improvement of students attitudes towards biology ,leading to increased motivation and interest. By providing engaging and interactive learning experiences, micro science kits fostered a sense of curiosity and motivation among students**.**

4.3.3. Theme: Positive Attitude

The micro science kits promoted a positive attitude towards practical biology work among students. According to Teacher 3, "*Students' attitudes towards practical biology work have improved dramatically. They're more confident and excited about learning*." Students reported enjoying the

hands-on experience, with one noting, "*The kits made practical biology work more enjoyable and helped me understand the concepts better*" (Student 3). Researchers' direct observations revealed that students displayed increased confidence, enthusiasm, and a sense of accomplishment when working with the kits. This finding is consistent with research by Osborne and Dillon (2008), who emphasize the importance of practical work in developing positive attitudes towards science. By providing engaging and interactive learning experiences, micro science kits fostered a positive and supportive learning environment.

The findings suggest that micro science kits had a positive impact on student engagement, motivation and attitudes towards practical biology work. Teachers reported increased participation, enthusiasm and confidence among students. These findings highlight the potential of micro science kits to enhance the learning experience and promote a positive classroom environment.

4.4 Summary

The chapter dealt with data presentation, analysis and discussion of collected data the researcher. The chapter focused on the benefits derived from using micro science kits in enhancing practical skills in biology on students. These are include accessibility and engagement, development of practical skills, cost effectiveness and sustainability, safety and environmental benefits, enhanced understanding of biological concepts. The competence that are gained by students through using micro science kits were outlined and discussed chief among them include observation, scientific inquiry, practical skills, critical skills and collaboration. The ended by looking the impacts of micro science kits on student engagement, motivation, and attitudes toward practical biology work. In chapter 5, recommendations and conclusions based on research findings were made.

CHAPTER 5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

This chapter summarizes the research design, key findings, and conclusions drawn from the study assessing the benefits of micro science kits on practical skills development in biology students. It provides an overview of the research problem, highlights from chapter 1 to 4 and discusses the findings in relation to existing literature. The chapter also presents research recommendations based on the study's results.

5.1 Summary of the research.

Chapter 1 focused on the problem, its setting and outlining the objectives of the research, which sought to answer. The study aimed at assessing benefits of using micro science kits in enhancing practical skills developing in Biology students. In chapter 2 ,literature related to the use of micro science kits was explored thereby serving as a pedestal for the research findings discussed in Chapter 4.The chapter also gave an overview of the concepts of micro science kits in relation to the traditional macro science kits. Chapter 3 of the study focused on the research design that was qualitative. It employed direct observations, in-depth interviews and questionnaire as research instruments. In chapter, four of the study, a presentation and discussion of research findings were dealt with. The chapter presented the research findings in the form of emerging themes. Findings were discussed , linked to some literature that was reviewed in Chapter 2 and at the same time supported by other studies done earlier.

5. 2. Constraints

The study was successfully completed; however, the researcher encountered several challenges that influenced its progression. The constraints included, limited financial resources hindered the researcher's ability to print and photocopy necessary materials, restricting the scope of data collection. As an employee of the Ministry of Primary and Secondary Education with teaching

responsibilities, the researcher faced significant time limitations, balancing research obligations with professional duties and struggling to devote sufficient time to the study. Lastly, frequent power cuts disrupted the research process, particularly during data analysis and document preparation, leading to delays and inefficiencies.

5.3 Conclusions

The following conclusions were drawn from the study:

- The use of micro science kits at Matsine Secondary School significantly enhances practical skills development in biology students, leading to improved scientific literacy and competence.
- Micro science kits specifically improve skills such as observation, measurement, experimentation, and data analysis in biology students, preparing them for more advanced scientific inquiry.
- The integration of micro science kits in biology education boosts student engagement, motivation, and enthusiasm for practical work, leading to a more enjoyable and interactive learning experience.
- The use of micro science kits fosters positive attitudes towards biology and practical work among students, promoting a deeper interest in scientific exploration and discovery.
- Micro science kits are an effective teaching tool for biology educators, enabling them to create engaging, hands-on learning experiences that cater to diverse student needs and abilities.

These conclusions can inform educational practices, policy decisions, and future research on the use of micro science kits in biology education.

5.4 Recommendations

Based on the findings and discussions presented in the preceding chapters, the following recommendations were proposed to enhance the utilization of micro-science kits in the teaching and learning of biology in secondary schools;

- Matsine Secondary School should consider integrating micro science kits into the biology curriculum to enhance practical skills development and student engagement.
- Provide professional development opportunities for biology teachers to effectively utilize micro science kits and develop innovative lesson plans.
- Allocate sufficient resources to acquire micro science kits and maintain them to ensure continued effectiveness in enhancing student-learning outcomes.
- Regularly monitor and evaluate the effectiveness of micro science kits to identify areas for improvement and optimize their use in biology education.
- Consider expanding the use of micro science kits to other science subjects, such as chemistry and physics, to create a more comprehensive and engaging STEM education program.

These recommendations can inform educational practices, policy decisions, and resource allocation to enhance the quality of science education at Matsine Secondary School.

APPENDICES

APPENDIX 1

INTERVIEW GUIDE FOR LEARNERS

Objective:

To evaluate the impact of micro science kits on student engagement, motivation, and attitudes towards practical work in biology.

Interview Questions:

Section 1: Student Engagement

1. Can you describe your experience with micro science kits in biology practical work?

2. How did the use of micro science kits affect your level of engagement during practical lessons?

3. What specific aspects of the kits did you find most engaging?

Section 2: Motivation

1. Did the use of micro science kits motivate you to participate more in practical work? Why or why not?

2. How did the kits influence your interest in biology?

3. Can you share any experiences where the kits sparked your curiosity?

Section 3: Attitudes towards Practical Work

1. What are your thoughts on the effectiveness of micro science kits in enhancing practical work in biology?

2. Did the kits change your attitude towards biology practical work? If so, how?

3. Would you recommend using micro science kits for future biology classes?

APPENDIX 2

INTERVIEW GUIDE FOR TEACHERS

Objective 1: Effectiveness of Micro Science Kits in Enhancing Practical Skills

1. How do you think micro science kits have influenced students' practical skills in biology?

2. Can you describe any specific skills or techniques that students have improved upon using the kits?

3. How do you assess student practical skills when using micro science kits?

Objective 2: Competence Skills Improved by Using Micro Science Kits

1. Which specific competence skills do you think students have developed through using micro science kits (e.g., observation, measurement, experimentation)?

2. How have micro science kits influenced students' ability to design and conduct experiments?

3. Can you provide examples of how students have applied scientific concepts and principles using the kits?

Objective 3: Impact of Micro Science Kits on Engagement, Motivation, and Attitudes

1. How have micro science kits affected student engagement and participation in practical biology lessons?

2. Do you think micro science kits have motivated students to learn biology? If so, how?

3. Have you observed any changes in students' attitudes towards practical biology work since introducing micro science kits? If yes, please describe.

APPENDIX 3

QUESTIONNAIRE GUIDE FOR LEARNERS

Attitudes towards Practical Work and Perceptions of Micro Science Kits

Section 1: Attitudes towards Practical Work

1. How important is practical work in biology to you? (Scale: 1-5, where 1 = Not Important, 5 = Very Important)

2. I enjoy conducting experiments in biology. (Scale: 1-5, where 1 = Strongly Disagree, 5 = Strongly Agree)

3. Practical work helps me understand biological concepts better. (Scale: 1-5, where 1 = Strongly Disagree, 5 = Strongly Agree)

Section 2: Perceptions of Micro Science Kits

4. Micro science kits make practical work more engaging. (Scale: 1-5, where 1 = Strongly Disagree, 5 = Strongly Agree)

5. The kits are easy to use. (Scale: 1-5, where 1 = Strongly Disagree, 5 = Strongly Agree)

6. Micro science kits help me develop practical skills. (Scale: 1-5, where 1 = Strongly Disagree, 5 = Strongly Agree)

Section 3: Effectiveness of Micro Science Kits

7. The kits enhance my understanding of biological concepts. (Scale: 1-5, where 1 = Strongly Disagree, 5 = Strongly Agree)

8. I feel more confident conducting experiments with micro science kits. (Scale: 1-5, where 1 = Strongly Disagree, 5 = Strongly Agree)

9. The kits promote critical thinking and problem-solving. (Scale: 1-5, where 1 = Strongly Disagree, 5 = Strongly Agree)

Section 4: Open-Ended Questions

10. What do you like most about using micro science kits in biology practical work?

11. What challenges have you faced while using the kits?

12. How do you think micro science kits can be improved?

Section 5: Additional Feedback

13. How often do you think micro science kits should be used in biology classes? (Scale: 1-5, where 1 = Rarely, 5 = Frequently)

14. Would you recommend micro science kits to other students? (Yes/No)

15. Do you think micro science kits are a valuable addition to biology education? (Yes/No)

Section 6: Demographic Information

16. What is your current grade level?

17. What is your favorite aspect of biology? (Open-ended)

18. How do you think practical work can be made more enjoyable? (Open-ended)

19. Have you used micro science kits in other subjects? (Yes/No)

20. Any additional comments or suggestions about micro science kits? (Open-ended).

APPENDIX 4
LETTER SEEKING PERMISSION TO CARRY OUT RESEARCH

Matsine Primary School
P. O. Box 98
Harare

10 March 2025

The DSI Wedza
Ministry of Primary and Secondary Education
Box 00
Wedza

Dear Sir

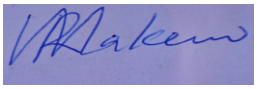
REF: REQUEST TO CARRY OUT AN ASSESSMENT INTO THE BENEFITS OF MICRO SCIENCE KITS ON PRACTICAL SKILLS DEVELOPMENT IN BIOLOGY STUDENTS

I am studying for a Bachelor of Science education honours degree in biology and I am conducting a research on "Assessing the benefits of micro science kits on practical skills development in biology students".

In respect of the above, I humbly request the permission to conduct the research.

Thank you in advance.

Yours sincerely.



APPENDIX 5

DIRECT OBSERVATION GUIDE

Observation guide content

The observation guide included items such as

- Students' ability to follow instructions and use the micro science kits correctly
- Students' engagement and participation during practical activities.
- Students 'ability to observe ,measure and record data accurately
- Students' collaboration and communication with peers during practical work
- Students 'ability to analyse and interpret data

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