

BINDURA UNIVERSITY OF SCIENCE EDUCATION

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BACHELOR OF SCIENCE EDUCATION HONOURS

DEGREE IN BIOLOGY



**AN INVESTIGATION
INTO THE BENEFITS AND CHALLENGES OF UTILISING MICRO SCIENCE KIT
ON LEARNING AND TEACHING OF BIOLOGY. A CASE STUDY OF
MUKWENGURE SECONDARY SCHOOL MUZARABANI DISTRICT.**

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PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE
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DECLARATION

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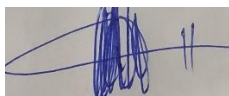
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DEDICATION

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.

ABREVIATIONS/ACCRONYMS

HBScEDBz - Honours Bachelors Science Education Degree in Biology

ABSTRACT

1.1 Abstract:

Micro science kits have emerged as an innovative approach to teaching and learning of biology in secondary schools. These portable, self-contained kits allow students to engage in hands-on experiments and investigations, even in set ups with limited laboratory resources. This study aims to investigate the benefits and challenges of utilizing micro science kits in the teaching and learning of biology. A qualitative research design method was employed in data collection. The study was conducted at Mukwengure secondary school. Students were given access to micro science kits and their learning outcomes, engagement, and perceptions were evaluated. Data was collected through focus group discussions, interviews and observations. Teachers and students were interviewed to get meaningful feedback. The findings suggested that the use of micro science kits in biology instructions can lead to several benefits, including significant improvement in student learning outcomes, enhanced engagement, and more positive attitude towards the subject matter. Students were able to actively participate in hands-on experiments and develop a deeper understanding of biology concepts. However, the study also identified challenges, such as the need for proper training and support for teachers, the availability and affordability of the kits, and the integration of the kits into the existing curriculum. The conclusions from the study provide valuable insight for educators, policymakers, and curriculum developers in exploring the potential of micro science kits to improve the teaching and learning of biology in secondary schools. Recommendations are made to address the identified challenges and further enhancing the effectiveness of this approach in the classroom.

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CHAPTER 1: INTRODUCTION

1.0 Introduction

Every aspect of life is influenced by science and biology. Realizing the importance of science process skills, as solutions to scientific problems and national development. The government of Zimbabwe and various professional bodies like UNESCO put in place initiative of the provision of micro Science kits to schools. This was initiated so that when learners pass their ordinary level, they would have acquired enough scientific skills such as observing, classifying, measuring and experimenting and to address the low pass rate in science subjects. In schools the hands on Science education tends to be hindered by resource intensiveness and most schools are experiencing financial shortfalls to buy micro science kits. To effectively learn Science, students need to learn more than just facts and theories, but however there is need to construct their understanding through the hands on approach .The introduction of science kits in schools is cost effective and most schools can afford it. The current education system in Zimbabwe is also backed by these micro science kits, as it seeks to satisfy the philosophic school of pragmatism, where learners are involved in continuous assessment learner activities. The kits are mini equipments that offers a basic secondary level scientific education. In other words, use of micro science kits become the way to go through which teaching and learning can be done in this era of producing or modeling a person who is an employer rather than job seekers produced from the old curriculum of the education system of Zimbabwe. Thus this study aims to determine the benefits as well as the challenges of using micro Science kits in teaching and learning of biology.

1. 1. Background of the study

Micro science kits are veritable mini laboratories that come with booklets and teaching materials describing scientific experiments (UNESCO, 2018). This innovation is necessary in Zimbabwe as a developing country which cannot afford to fully equip education institutions with macro science kits or laboratories. Chaudhary and Kumar, (2020) note that developed countries are more advanced as compared to developing countries.

In response to vision 2030, economic road map for Zimbabwe to be the upper middle income economy, the education system is the footstool of this national vision being witnessed by the distribution of micro science kits in schools. This will see the country embracing globalization in science and technology, as mastering and understanding basic skills and

concepts are now highly recognized and adopted equally in many schools in Zimbabwe in the teaching and learning science, technology, engineering and mathematics (STEM) (Smith and Jones, 2021). In embracing the use of micro science kits in teaching and learning of Biology there will be improvement on learner performance. Also students with better symbols will be produced who will then further their studies in sciences promoting industrialization in their country.

Micro science kits play a pivotal role in line with catch up programs in view of disruptions by Covid 19 pandemic era, where the education system cannot be spared from the shock. Covid 19 changed everything in the education sector Chen and Howard (2019). Poor performance in science subjects have been reported by various scholars in Zimbabwe including the Zimbabwe School Examination Council (2019) report, Akuma and Callagham (2019), Chen and Howard (2019). The low performance was as a result of a lot of challenges including shortage of laboratories, lack of concrete material in the teaching and learning and also shortfall of qualified science teachers. As a way to address some of these challenges UNESCO together with the Ministry of Primary and Secondary Education and Ministry of Education and Vocational Training introduced micro science kits as a way to promote learning of sciences through the use of practical materials. Also the government of Zimbabwe in 2011, initiated a program in which a good number of science teachers were trained under Visual Open Distance Learning (VODL) and were deployed to rural schools to close the gap whereby science subjects only taught by qualified teachers in urban schools.

Therefore, the researcher will undertake a study, investigating the extent to which the introduction of micro science kits has benefitted teaching and learning process, as well as identifying the challenges encountered in teaching and learning Biology.

1. 2. Statement of the problem.

Lack of hands-on approach in learning and teaching Biology is affecting the performance of biology students and the teaching process. The present school curriculum is accommodating and promoting pragmatic approach in teaching and learning so as to produce graduates who can solve

problems through observations and critical thinking, of which these skills are developed through the use of micro science kits.

Micro science kits are panacea to the education sector as they are effective and help biology learners to grasp concepts more easily, especially considering the gap created by Covid 19 induced lockdowns, as stated by Syer, Chichekian, Shore and Aulis, (2015) governments across Africa had to close educational institutions as early as 2020. Complex content can be understood quickly and more easily through the use of concrete material or aids. The poor performance in Biology, chemistry, physics and agriculture have profound effects in national development that will emanate to the lack of innovation, poor agro economic developments, poor health resulting in high mortality rates. All these factors have triggered the researcher to investigate the benefits and challenges faced in the utilization of micro science kits in the teaching and learning of Biology as one of the key science subjects.

1. 3. Purpose of the study.

The main aim of this study is to bring about the benefits of using micro Science kits in the teaching and learning of Biology and highlight some challenges that maybe encountered when using these kits. It does so by making specific reference to Mukwengure Secondary school in Muzarabani district, Mashonaland Central province of Zimbabwe.

1. 4. Objectives of the study

The study aims to:

1. Identify the advantages of using micro science kits in the teaching and learning of Biology
2. Identify the challenges faced in the use of micro science kits in the teaching and learning of Biology.
3. Assess the attitude of biology teachers and learners in using the micro science kits.
- 4 assess if micro science kits promote active learning?

1.5. Research questions.

With respect to the benefits and challenges of utilizing the micro science kits, the following research questions were advanced:

- 1 .what are the benefits of using micro Science kits in teaching and learning Biology?
2. Are there any improvements in student performance, following the utilization of micro Science kits in their teaching and learning?
3. What is the attitude of biology teachers and learners in using the micro Science kits?
4. Do micro science kits promote active learning in the teaching and learning of Biology?

1. 6. Assumptions of the study

It is assumed that the researcher will come across the research participants with zeal to give authentic information about their experiences in the use of micro science kits in teaching and learning. Also participants will show high level of cooperation and respond to research questionnaires accurately. Mores, it is assumed that questionnaires will reflect what is expected.

1. 7. Significance of the study.

The study will be of great importance to education sectors and curriculum planners, so that they promote and keep on improving the teaching and learning of science. Moreover, the study will be essential to parents, biology learners, teachers, school administrators and other stakeholders to appreciate the innovation of micro science kits in the teaching and learning of Biology. The use of science kits which are highly innovative and new is of much importance to biology teachers and learners. The researcher will explore the benefits of utilizing micro-science kits as well as challenges unveiled in the study. Recommendations will be made for the near future.

1.8. Limitations of the study

The researcher is a full time classroom practitioner, professional duties will interfere with research activities. Also, the research is to carried out in an area where road network is in a very poor state, resulting in increased financial challenges from hiring transport. Researcher will make use of all available opportunities to ensure success and validity of the study.

1.9 Delimitations of the study

The research will be limited to one Secondary school selected from Muzarabani district, Mashonaland Central Province, which offers biology at ordinary Level.

1.10. Definition of key terms.

Micro Science kits are veritable mini laboratories that come with booklets and teaching materials describing scientific experiments, Gall (2019).

Teaching is the engagement with the learners to enable their understanding and application of knowledge, concepts and processes delimitations, (Smith and Jones, 2018).

Syer et al (2015) state that learning is a process of acquiring new understanding, knowledge and behaviors, skills, values, attitudes and preferences.

1.11. Summary

This chapter highlighted the background of the research study, the statement problem, research objectives and questions, significance of the research study, in relation to learning outcomes as expected by the new curriculum policy makers. The limitations and delimitations were discussed. Key terms used in the study were also defined. The next chapter will focus on literature related to the area under study.

CHAPTER 2: LITERATURE REVIEW

2.0 Introduction

This chapter focuses on the review of literature related to use of micro-science kits in teaching and learning of Biology. The chapter articulates the benefits and challenges faced by learners taught practical lessons using micro science kits at secondary school. Therefore, the literature would serve as the basis on which to develop the research findings, contextualizing of the literature to the problem. According to Brown and Lee, (2018), the kits are more convenient to store, easy to use and experiments are completed much faster. Micro science kits are easy to manage and transport. They can be used outside of a science laboratory since micro scale experiments are much safer, generate a lot less waste and they are portable, Lynch (2020). Brown and Lee, (2018) further indicate that with science experiment kits, biology students can actively participate in learning by conducting experiments themselves. This hands-on experience deepens their understanding of scientific concepts and enhances their problem-solving skills. Science kits are a unique and practical way for biology students to learn about the world around them. Nguyen and Tran, (2023) also argue that the kits are ideal for gifting and can be an outlet for student's creativity, making them an invaluable toy to get for child. Biology teachers and parents find these kits very useful in educating their children because the kits help teach both the in-depth principles of science and the hand-on learning of science. There are many companies that deal in science experiment kits that are designed to provide knowledge in different scientific field. These and other benefits will be explored. Challenges of using the kits will also be discussed hereunder.

2. 1. Benefits of using micro science kit in teaching and learning Biology.

Micro-science kits are more convenient to store, are easy to use and allow experiments to be completed much faster. They are easy to manage and transport and can be used outside of a science laboratory, (Lee and Kim, 2023). Smith and Johnson, (2020) view them as safer, and can generate less waste and are portable. With science experiment kits, biology students can actively participate in learning by conducting experiments themselves. This hands-on experience deepens their understanding of biology concepts and enhances their problem-solving skills, (Gall, 2019). Science kits are a unique and practical way for a child to learn the world around them. Johnson and Smith, (2017), highlight that biology teachers find these kits very useful in educating children because they help teach both in-depth principles of science and the hands-on learning. Many

studies conducted before have revealed that the use of micro-science kits, have the following benefits to biology learners and teachers; boosting teachers' confidence and knowledge, making lessons easier to deliver, teachers become more generative in their thinking, development of psychomotor skills in learners, are cost effective, allow learners to acquire practical skills and are easy to store, (Lee and Kim, 2023; Garcia and Martnez, 2019).

2. 1. 1. Boost teachers' confidence and knowledge

According to Jang and Park, (2023), the use of micro Science kits increase teacher confidence and knowledge about Science teaching because the kits normally contain the handbooks for teachers. These books explain how to use kits and how to carry out the experiments. This increases biology teachers' confidence and they will be able to introduce new concepts to their own biology students, (Lee and Kim, 2023). The use of science kits especially in rural areas where there are no laboratories, enable biology teachers not to have to struggle to find or improvise practical materials. They need not to worry about storing large quantities of resources and materials. The materials in kits are small and easy to handle that teachers do not worry about the kids breaking them because they are mostly made of plastic, (Gall, 2019).

2. 1 .2. Teachers become more generative in their thinking.

Lee and Kim, (2023) also note that the micro Science kits help biology teachers become more generative in their thinking about how to support Science inquiry learning. This is critical in creating new and alternative activities. Teachers will be able to apply what they learnt from using the kits, to new teaching situations. The kits include a capacity building component for teachers by allowing them to manipulate and create different activities depending on the demands of their own classroom, (Gall, 2019).

2. 1. 3. Lesson becomes easier to deliver

Johnson and Smith, (2017), testify that practical sessions are much easier when biology students seem to be more interested with new small scale science equipments. Also, it was noted by Gall, (2019), that biology teachers are excited, with the way learners' master concepts at the end of the lesson. Lessons involving the science kits are easier to do. They also enable both the biology teachers and biology students to participate actively and effectively during lessons, (Johnson and Smith, 2017),

2. 1. 4. Storage and safety.

In terms of storage and safety, traditional equipment requires full science laboratories. However, these micro science kits are user friendly and portable and they occupy a small space. According to (Lee and Kim, 2023) there is clear evidence that micro Science kits have positive impacts on biology teachers and their students. Conducting biology lessons using micro Science kits is valuable for the safety issues, both in handling and disposal of hazardous substances. Chances of accident occurrences are minimized by using micro scale approach. Another benefit of micro Science kits is that experimental learning or learning by experience is essential for turning knowledge into wisdom for biology learners. It helps them acquire more knowledge and ensure that the learning stays in mind for a longer time, (Lee. and Kim, 2023).

2. 1. 5. Skill acquisition.

The science kits are designed to help develop a number of skills in the learners and also dividing the learning process in two phases which are as follows .The first phase is that learners build the experimental set up and visualize the scientific phenomena,(Jang and Park, (2023). The second phase is that biology learners are able to be introduced and challenged to have an understanding on some principles based on certain phenomenon, being guided by a handbook. The micro Science kits approach makes the scientific experience more inclusive, stimulating the interest and passion of the biology pupils, according to Gall, (2019).

Classroom teaching will not be sufficient without hands-on approaches which make learners to grasp the experimental concepts. This is achieved by using micro science kits. It makes teaching and learning more effective for the biology students and their teachers. Mafumiko (2020) discovers that the use of micro kits in Biology teaching and learning improves students' participation and creates a conducive learning environment for biology learners. Various studies have shown the effectiveness of using micro Science kits for instance in Nigeria, investigations by Nguyen and Tran (2023) reveal that academic achievement where micro Science kits are used, are far much good when compared to where students learn Biology without the kits.

Also, a research study by Johnson and Smith, (2017), show that attitude of biology teachers and students towards use of micro-science kits on practical work, was strongly positive. The kits make learning more interesting, practical, realistic and appealing. They give room for acquisition of skills and knowledge and development of self confidence and self actualization. Students who use

technology in the classroom may be more engaged. When schools have a 1:1 initiative (one device for every student), biology students benefit because technology can be more smoothly integrated into the curriculum, Mafumiko, (2020).

With science experiment kits, biology students can actively participate in their teaching and learning by conducting experiments themselves. This hands-on experience deepens their understanding of scientific concepts and enhances their problem-solving skills. In addition, in the classroom, instead of memorizing facts, students work together in small groups analyzing real data, including microscopy images and western blots, (Lee and Kim, 2023)

2. 1. 6. Cost effective.

Micro-science kits are inexpensive as compared to the traditional macro Science kits. The study conducted by the University of Witwatersrand on the trail introduction of RADMASTE in Biology practicals proved that the cost of providing and using micro-science kits is low when compared with the use of macro kits in terms of apparatus and chemicals. Due to the small size of the apparatus in science kits, they require few chemicals, (Jang and Park, 2023). Schools with limited budgets can still provide quality biology education to their learners using the kits which require few chemicals.

Johnson and Smith, (2017), further note that the use of micro science kits in the learning process involves active biology student participation and this create a long term attainment of content and objectives. The mini equipments are worth being used in Biology practical work as they improve the learners' skills and academic achievements, (Choi and Lee 2014).

2. 1. 7. Development of psychomotor skills

According to Smith and Lim, (2024), the use of micro science kits help biology students construct their knowledge, develop logical and inquiry type skills and develop psychomotor skills. Also, practical work may be considered as engaging the biology learner in observing or manipulating real or virtual objects and materials Wosenga, (2020). Therefore, incorporation of this new situation of micro science kits in teaching and learning Biology shall produce a biology learner who is competent in scientific skills. It also enables students to think in a scientific manner, (Smith and Lim, 2024). The experiments learners they do teach them to draw their own conclusions as well as acquainting them with the scientific process. Also active learning engages biology students

learning through activities and/or discussions in class, as opposed to passively listening to the teacher.

2. 2. Teachers' attitude in using micro-science kits.

Highly scientific Teachers exhibit the following scientific attitudes in descending order: open-mindedness, resourcefulness, and creativity, respect for evidence, believing in cause and effect of relationships, curiosity, questioning attitude, honesty, intellectual responsibility, humility, and patience and determination, Wosenga, (2020). Also, a research study by Johnson and Smith, (2017), show that attitude of biology teachers and students towards use of micro-science kits on practical work, was strongly positive.

2. 3. Attitude of learners in using micro science kits

Akpan and Nwokah, (2023), found out that the biology students' attitude towards science increase positively after using the micro science kits as compared to where theoretical lessons are done. According to the authorities, learners are excited if the learning process is active. Mafumiko, (2020) also discovered that the use of micro science kits results in happiness and excitement among learners. The findings of happiness and excitement after learning practical using micro science kits have also been supported by the studies which were carried out by Brown and Lee, (2019) who found differences in attitude among participants when micro science kit are used.

Observations made by Brown and Lee, (2019) show that biology students trained using micro scales techniques change their perception on the environment since the micro scale experiments are safer and are more environmental friendly. In the study it was also found out that micro scale experiments provide the opportunity to raise awareness of the values of environmental stewardship into pre-college biology students regardless of the field in which their interest lies, Akpan and Nwokah, (2020). This study aims to explore the same but in a Zimbabwean context.

2. 4. Challenges of utilizing the micro Science kits in teaching and learning of biology.

The use of science kits in the teaching of biology though has benefits, also have some challenges. Some of the challenges found include; lack of awareness and exposure, resistance to change, mismanagement of science kits and their demand for more student attention.

2. 4. 1. Lack of awareness and exposure

According to Akpan and Nwokah, (2023), the use of micro science kits face drawbacks like; lack of awareness and exposure by both biology teachers and students; lack of policy supporting the implementation and low accessibility to the kits by most schools. Another challenge is that, since science kits are small, they do not have all necessary materials for all practicals to be done, for example, the absence of chemicals which are important for some practical activities are not available, (Chen and Wang, 2020). In addition to this, the available kits in schools might not be adequate for or do not match the number of biology students. So the teacher has to improvise some of the apparatus to cater for the large numbers of biology students, (Chen and Wang, 2020).

2. 4. 2. Resistance to change

A study conducted by Chen and Wang, (2020) shows that micro Science kits are not really contributing much to the development of specific manipulative skills and the techniques related to the use and handling of the traditional macro science kits for example triple beam balance and measuring cylinder, only but to mention a few. Biology teachers were seen also to have a tendency of resisting change. They appear to be very passive in using the micro science kits and end up living them idle. Bradley, (2018) conducted a study in Mpumalanga Schools in South Africa and found that biology teachers face challenges in implementing and using the micro Science kits due to lack of knowledge.

2. 4. 3. Mismanagement of science kits.

Brown and Lee, (2019) note that the micro Science kits are generally small and since the apparatus are small, there is mismanagement of them and some kits are lost.

2. 4. 4. Demand more student attention.

Biology learners with poor attention might find it difficult to use micro Science kits. Research carried by Chen and Wang, (2020) indicate that using micro science equipment demand more student attention.

Based on the related literature, it's apparently clear that micro-science kits are critical in the teaching and learning of biology in secondary schools. The kits have proved to benefit biology teachers as well as their learners. More so it has been highlighted that they instill skills necessary

in the lives of biology learners. However there are demerits of using the same apparatus according to the discussions in this chapter.

2. 5. Summary

This chapter has reviewed literature related to the problem to be investigated in the study, that is, the benefits and challenges of utilizing micro science kits in secondary schools biology teaching and learning. The gathered information will be used as a theoretical framework to judge the data collected from the field. From that perspective conclusion will be drawn.

CHAPTER 3: RESEARCH METHODOLOGY

3.0 Introduction

This chapter dwells on the research method employed during the research. Due to the nature of the research. A qualitative research method was used in this chapter. The research methodology discussed include the, research design, population, sample and the sampling procedure, research instrument used for data collection, ethical considerations, data collection approaches as well as data presentation and analysis .The research took a qualitative case study.

3.1 Research design

Brown and Lee, (2019) define research design as a plan for study, providing the overall frame work for collecting data. Gall (2019), defines it as a plan for selecting subjects, research sites and data collection procedures to answer the research questions. The research methods used in this case to investigate the benefits and challenges of using micro-science kits in the teaching and learning of biology are qualitative.

A case study was used. The researcher focused mainly Mukwengungure secondary school in Muzarabani. A case study is defined as a research approach that is used to generate an in depth multi-faceted understanding of a complex issue in its real life context Chaudhary and Kumar, (2022). There are three reasons why a case study was employed in this study. It's descriptive, explanatory and evaluative, that's according to Gall, (2019). In regard to this argument, the design was chosen because it enabled the researcher to make use of several approaches to research Brown and Lee, (2019).

The school used for the research is located in Muzarabani district, Mashonaland central. It is about sixty kilometers north of Mvurwi town. It is a day school which offers ordinary level biology. With an enrollment of around one thousand learners, thirty are biology students. From the population of biology students, the researcher drew a sample of twenty learners and all the three biology teachers.

Ten of them were the experimental group and another ten, the control group. The experimental group received instruction using micro science kits while the control group received traditional, non-kit-based instruction. The micro science kits included materials and equipment for

experiments related biology topics. Reputable educational suppliers of laboratory equipment provided the kits.

3. 2. Population

Brown and Lee, (2019) view population as the entire group of individuals, cases, or data points that a researcher is interested in understanding or describing. The authority further defines it as the target group that a researcher wants to draw conclusions about. In this study, twenty ordinary level biology learners and their three teachers at Mukwengure secondary school made the population.

3. 3. Sample

A sample is a subset of individuals, cases, or data points selected from a larger population, used to represent the population in a research study, (Malcolm, 2014). A sample is typically a smaller, manageable group, chosen to participate in a study, and is used to draw inferences about the characteristics, behaviors, or attitudes of the larger population, (Malcolm, 2014). In this study, ten biology learners and their three teachers were used. The number was considered qualitatively large enough to produce reliable and valid results that can be generalized. More so, it was easy to reach and collect data from as they were at the same station.

3. 4. Sampling procedures.

According to Gall, (2019), sampling procedure is the process of selecting units from a population of interest so that by studying the sample one may fairly generalize the results back to the population from which they were chosen. The researcher decided to use, random sampling (stratified) and non-random (purposive) sampling approaches. According to Gall (2016), purposive sampling is a technique used where respondents are selected according to the objective of the study. The respondents in this case were biology teachers and their learners, and that alone made them participants. Biology teachers and learners were grouped as such using stratified random sampling technique. According to Malcom, (2017), stratified sampling is used when representatives from each sub group within the population need to be represented. This was true about the study as every category was fairly represented and findings would not be biased but reliable and valid. Simple random sampling was used in identifying the actual respondents in each sub group.

3. 5. Research instruments.

Research instrument is defined as a tool used to collect, measure and analyses data related to the research interests. The researcher managed to use unstructured interviews, focus group discussions and observations as the forms of data collection techniques. These methods were employed so as to achieve high levels of reliability and the validity of the information, Malcom, (2017). These instruments are cost effective, and easy to administer. Since the researcher is a classroom practitioner, learners need their attention, the researcher decided to use the instruments for convenience's sake. More so, the instruments are time serving.

Focus Group Discussions (FGDs) offer several advantages as research instruments and according to Malcolm, (2017), the advantages given hereunder made the researcher to use the instrument in data collection. Mukono, (2021), believes that FGDs allow for the collection data from multiple participants simultaneously, making them more efficient than individual interviews. Since it was a group of learners, it encouraged participants to engage in discussions, share experiences, and build on each other's ideas. That allowed the researcher to triangulate data, increasing validity by cross-checking information across participants. The environment created by focus group discussions was comfortable and encouraged learners to share their thoughts and opinions openly. Researcher observed and recorded data in real-time, reducing reliance on self-reported data. The instrument allowed for the validation of findings by summarizing and confirming learners' statements during the discussion.

On the other hand, interviews were conducted with part of the participants. Interviews can be used in data collection for several reasons. Interviewers can observe non-verbal cues, such as body language and tone of voice, providing additional insight. Interviews offered a powerful tool for data collection and allowed for the gathering of detailed and contextualized information from the respondents, providing insights into their thoughts, feelings, and experiences,(Brown and Lee, 2019)

After the researcher had noted all these advantages, of using each instrument, it was conveniently suitable to use the instruments mentioned in the research study.

3.5.1. Interview guide for learners.

An interview is defined as a procedure designed to obtain information from a person through oral responses to oral inquiries Malcolm, (2017). Unstructured interviews were used on ordinary level biology learners at Mukwengure. About twenty of them took part in the exercise. The interview questions were unstructured and mainly focusing on the merits of using micro Science kits and the demerits of using micro science kits at Mukwengure Secondary School in Muzarabani District. The interview gave the researcher the opportunity to understand biology learners' personal opinions, beliefs and values. It also enabled the researcher to understand body language and facial expressions. However the interview sessions consumed much time than was anticipated. The guide for biology learners is shown in Appendix 1.

3.5.2. Focus group discussion guide for learners

The study used focus group discussions to get information from learners on the challenges and benefits of using micro science kits in the teaching and learning of Biology in secondary schools, particularly at Mukwengure secondary school in Muzarabani. Gall, (2019) defines a focus group discussion as a way to gather information by gathering together people from similar backgrounds to discuss a specific topic of interest. In this study, ordinary level biology students at Mukwengure secondary school were gathered together to discuss the benefits and challenges of utilizing the micro science kits in teaching and learning of Biology. This instrument was used since it provides rich, qualitative data, participants' thoughts, feelings, and experiences. More so, interactions among participants reveal social norms, influences, and perspectives that might not emerge in individual interviews. Learners' spontaneous comments and reactions offer authentic and unfiltered insights. Refer to appendix IV. This instrument allowed the researcher to collect data with learners engaging in discussions, sharing experiences, and building on each other's ideas, (Gall, 2019) finally it allowed the researcher to triangulate data, increasing validity by cross-checking information across participants. By leveraging these advantages, researcher harnessed the power of the instrument to gather valuable insights on the research study.

3.5.3. Interview guide for biology teachers

The researcher asked questions from the interview guide as indicated in appendix II. Notes from the respondents were taken, for analysis and presentation. Respondents were given time to respond to in turns during the sessions. The interviews were done in three days. Each session would

take almost 2 hours. Teachers at Mukwengure secondary school assisted by reading some interview questions. Interviews were used since they offer several advantages in data collection. For example they provide rich, detailed data. In addition to this, interviews reveal personal experiences, beliefs, and values, and provide context to participants' responses. Researcher could ask follow-up questions, clarifying and exploring interesting points or contradictions. This increases the likelihood of honest and open responses from respondents. The data provided have high chances of being valid as interviews give firsthand information, (Brown and Lee, 2019). Having considered these advantages, this research instrument was used in this study.

3.5.4. Observation Guide

It's a research method in which the researcher takes part in the activities and daily life of the group being studied, (Johnson and Smith, 2017). In order to gain a deeper understanding of the behaviors, norms, and experiences of learners, the researcher became part of the learners. Researcher participated in learners' activities and routines over an extended period of three weeks. While participating, the researcher also carefully observed biology learners' behaviors, and practical and traditional group of the sample. This was done to ascertain the impact of teaching and learning of biology using micro kits and not using the kits different, to the advantage or disadvantage of learners. Detailed notes and recording of observations was done. The major advantage of participatory observation is to gain an in-depth, contextual understanding of the group being studied that would be difficult to achieve through other research methods alone. It allows the researcher to study human behavior, Wosenga, (2020)

3.6. Procedures for collecting data.

The researcher initially sought permission from the Ministry of primary and Secondary Education, to undertake the study, by applying for permission from the DSI Muzarabani District, Mr Kagura. After permission was granted, researcher went on to contact the responsible authorities at Mukwengure Secondary School. A briefing on the study to be conducted at the school occurred. A consensus was reached that the research be done. Interview dates were agreed on. Chen and Wang, (2020) say that a pilot test is done before the actual data collection day, using designed tools, to ensure a well prepared and effective data collection process. According to the authorities pilot testing ultimately leads to more reliable and valid research findings. Wosenga, (2020) sees

pilot testing as good in helping researcher estimate the time required for data collection, allowing for planning accordingly and sufficient allocation of resources.

Having noted that, a pilot test was done, to measure the validity and reliability of the instruments with just a few biology learners, (Ball, 2021). These weren't part of the respondents. After pilot testing, interview dates were set.

Interviews were done with the sample, biology learners and biology teachers, during break time, to avoid disrupting their lessons. The actual interviews, focus group discussions and participatory observations then followed and were conducted successfully. Interviews were conducted in four weeks. Each session would need up to two hours, where each participant would need an average of twenty minutes interview time. Two times a week and in the afternoon, interviews were done at the school. Focus group discussions were done for about an hour each session. This took three weeks to be done with the learners at the school. Participatory observations were carried out with the researcher observing biology learners taught using the small kits and those taught without the kits. Data was collected and recorded accurately.

3.7. Validity and reliability.

According to Doodle, (2018), Reliability refers to the accuracy of the actual measuring instrument or procedure. Validity is the appropriateness, meaningfulness and usefulness of specific inferences made from the answers. In other words validity refers to which data is accurately reflecting the phenomenon under study. In regard to this study the researcher uses a qualitative research method and was reliable in conducting face to face deliberation. To ensure validity and reliability of results, a case study was chosen. The researcher used the triangulation method on research tools. The researcher employs multiple research tools in order for the weakness of one tool to be compensated with other tool. Interviews, focus group discussion and observation was all be blended in order to come up with a good and reliable study outcome in as far as the challenges and benefits of using micro science kits in biology is concerned. To ensure validity of the study, Pilot study was done before the actual data collection was done and the researcher also conducted some Science teachers for guidance.

3. 8. Data presentation and analysis procedure

Due to the nature of the research methodology which is qualitative research method, themes and sub themes were generated from the data as well as objectives of the research study. Discussion of findings was linked to the literature review. In this regard, information that is common in satisfying each objective from different respondents formulated the themes on the challenges and benefits of utilizing micro science kits.

3.9. Ethical considerations.

Wosenga (2020) defines research ethics as moral obligations and principles that researchers should adhere to in carrying out and reporting their findings. Malcolm (2021) defines ethics as observations of what is good or bad. 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, protect the rights of participants and report results accurately Wosenga, (2020). The researcher made sure that participants were informed of all aspects of the study. Researcher sought authority from the ministry of Education and Mukwengure Secondary School to carry out a study at the station. Respondents were treated confidentially In order to maintain the integrity of the research study, and no data was falsified. On the issue of confidentiality, no names of participants were put in the write up or their insights disclosed to anyone. Respondents were told that results of the study were not to be communicated to anyone except to those concerned with supervision of the study, from the institution. They were all treated with respect and dignity.

3.10. Summary.

The chapter generally focused on research methodology used in this research study to investigate benefits and challenges of using micro-science kits in the teaching and learning of biology at O level. In particular, it detailed the research design, population, sample and sampling procedure. Instruments used in the research which include interviews, focus group discussions as well as participatory observations were used to gain a valid and reliable insight of the study. The procedure for collecting data, validity and reliability, data presentation and analysis procedures together with ethical considerations were fully discussed. In the next chapter, data presentation, analysis and discussions will be focused on.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION

4. 0. Introduction

This chapter dwells on the presentation, analysis and discussion of qualitative data which was generated from unstructured in-depth interviews, direct observations as well as focus group discussions, on benefits of using micro science kits in the teaching and learning of O level biology with reference to Mukwengure secondary school, in Muzarabani district. In this chapter the findings will be linked to the related literature and the discussion of the findings will also link with research questions and objectives.

4. 1. Benefits of utilizing micro science kits in biology teaching.

The findings below are the benefits of using micro science kits as found in the investigation. These are, improvement in the learners understanding of concepts being taught, safety and low costs, enhanced experimentation in teaching biology, accessibility, inquiry based learning and integration of technology. Enhanced experimentation in teaching biology offers several advantages, providing students with a more comprehensive understanding of biological concepts and processes. Here's a detailed look at how enhanced experimentation is an advantage in teaching biology, along with examples.

A biology teacher indicated that most of their lessons where micro kits are used have witnessed a large number of learners in attendance. They indicated that there is critical thinking and problem solving skills imparted in learners. *“Through enhanced experimentation, students are encouraged to think critically and develop problem-solving skills. Students must analyze data, draw conclusions, and propose solutions based on their findings and practical work they have done.”* Mberi and Phambili (2016) also noted that this process of inquiry-based learning fosters critical thinking skills and encourages students to approach biological problems analytically.

Most of respondents unanimously agreed that science kits provide students with the opportunity to apply theoretical knowledge gained from textbooks and lessons, to real-world scenarios. Mberi and phambili, (2016) gave an example where, students studying genetics in biology can use experimentation to understand concepts such as genetic inheritance and genetic variation. By applying theoretical knowledge in practical experiments, learners gain a deeper understanding of biological principles and their real-world applications. This resonates well with the findings of the study as was revealed by majority of the participants in this research study. *“Learners gain a deeper understanding of biology concepts when they apply theory to real world situations,”* said one of the teachers.

A learner also revealed that the use of micro science kits in learning and teaching of biology improves their understanding of concepts. Majority of the respondents on the focus group discussions also agreed to the same effect. The use of micro science kits improves student's understanding as compared to teaching biology theoretically. The respondent said, *“Ini kana teacher vachidzidzisa vachishandisa muromo chete ndobata nguva iyoyo ndotokanga”* (When the teacher teaches theoretically, I temporarily grasp and after the lesson, I forget everything). All this is in support of what Wosenga, (2020), postulates that micro-science kits improve learners' mastery of concepts.

From the participatory observations, the researcher also observed that majority of the learners participate greatly when micro science kits are used in lessons. This proved agrees with the literature by Wosenga, (2020). The authority noted that when compared to theoretical lessons, hands-on lessons motivate learners to greatly participate. In this study, learners greatly participated since they enjoyed using micro-science kits. Their assertion resonates well with what was discovered by Mafumiko (2018). The authority discovered that the use of micro experiments improves student's participation as well as sufficient grasping of biology concepts. Hands-on approach is very important and teachers should continue to apply it.

Teacher B from Mukwengure witnessed the same and added that, *‘those learners who are academically challenged are more active when the lesson involves micro-science kits “This is undoubtedly clear that these kits are crucial in the eaching and learning of biology.”* According to Mufumiko, (2018), active learner-participation in the teaching and learning of biology result in an

increase in the intellectual potency. The responses clearly show that learning of biology should be more practical, learners being more active in the process of their teaching and learning.

Wosenga, (2020) added that inquiry-based learning offers several advantages in teaching biology, fostering critical thinking, problem-solving skills, and a deeper understanding of biological concepts. Here are some examples of how inquiry-based learning is an advantage in teaching biology:

Data gathered is convincing that safety is insured with the use of micro science kits in schools. From the participatory observations done, most of the learners were able to use micro science kits and they were also able to handle them safely because they are small. In an interview, one of the respondents commented well on the issue of safety. The teacher said, “*Now that we are using the micro science kits, there is minimum breakage of items especially beakers and measuring cylinders.*” learners are handling apparatus well because they are small. Another student said “*utu tumaapparatis tudiki hatinetsu kubata hatuputsike. Zvasiyana nepataishandisa maapparatus mahombe.* (These apparatus are very small and they can be easily handled as compared to the traditional apparatus).

Majority of teachers and learners as respondents, showed interest in using micro science kits because of their safety and portability. Data from focus group discussion (FGD) and interviews showed that little chemicals are used with micro science kits, hence little exposure of student to potential risks of corrosive and toxic materials. Smith and Lim, (2024) argue that flammable solvents are very dangerous so using few chemicals help avoid laboratory mishaps. A study conducted by Wilson and Nguyen, (2024), indicate that micro science kits are valuable for safety issues, both in handling and disposal of hazardous substances. Sixty percent of learners agree that the kits are portable, hence less chances of laboratory accidents.

Safety is important in secondary schools during learning of science because it ensures students and teachers stay out of harm. Bunsen burners, chemicals and sharp tools pose potential hazards if used improperly. A learner indicated that, they were once affected by chemicals using the traditional large apparatus. The micro-kits pose less danger to them now due to their small size. Choi and Lee, (2024) believe that unsafe science laboratory or macro science kits can result in damage to

school property, serious injuries or death but micro science kits can minimize these dangers. The authorities have the same view as the participants in the research since they noted the same.

Cost-effective teaching methods in biology ensure that educational resources, such as laboratory materials, equipment and consumables, are more accessible to a wider range of educational institutions. For example, by utilizing micro science kits that require smaller quantities of materials, schools with limited budgets can still provide quality biology education to their students, (Choi and Lee, 2024). From the research, this was proven correct as the school used for the research is just but a small one. However it had some kits for their learners although the numbers are small.

The focus group discussions and interviews conducted reviewed that learners are enjoying the lessons using the micro science kits as compared to the lessons done theoretically. Respondent Learner A from Mukwengure secondary indicated that, "*We are enjoying science lessons nowadays because we are using these small apparatus to do experiments and it is exciting.*" The science teacher also indicated that it is interesting to teach using these micro science kits. Students are enjoying the lessons very much.

In summary, enhanced experimentation in the teaching and learning of biology provides students with a hands-on learning experience, fosters critical thinking and problem-solving skills, allows for the application of theoretical knowledge, and enhances student engagement and motivation. These advantages contribute to a more comprehensive and meaningful learning experience in the field of biology. The advantages are achieved when learners are active in their teaching and learning process. In this case, this is achieved with the use of micro-science kits.

4. 2. Challenges encountered when using micro-science kits.

The use of micro science kits in the teaching and learning of biology presents several challenges, as indicated by the search results.

Although the cost of micro science kits is low, it was observed that there are no adequate micro-science kits in schools. During an interview the respondent A from Mukwengure School indicated that, "*Tuma kit utwu turi bho kushandisa but tushoma. Hatikwane tese, totomirirana kushandisa kana kuti munhu one anoitira vamwe*" (The science kits are inadequate, we wait for each other or one person do it for others).

From this observation not every learner had access to the kits in learning and teaching of Biology. So not all learners would benefit from practical session due to the scarcity of practical equipment, hence the experiment would end up frustrating rather than motivating student. Ismail and Mohamed, (2014) also indicate that lack of hands-on experience does not provide the development of psychomotor skills.

The respondent B (teacher at Mukwengure,) also indicated the inadequacy of micro-science kits in schools. He said, *“There are inadequate micro science kits, so I end up being the one demonstrating to the learners.”* The learners lack hands-on approach. There is need for schools, with the help of government, to purchase adequate science kits for every learner to benefit.

Due to inadequacy of micro science kits in the school, the research, through participatory observation, revealed that some learners were unable to use the micro science kits. Mostly the teacher and a few would use the kits while others will be watching. One of the learners who were unable to use the kits was interviewed and said, *“I can't use some of the apparatus because most of the time we don't even touch them.”* The teacher and some learners do the demonstration for us. The focus groups discussions yielded the results that in the micro science kits some apparatus are not in the kits for example triple beam balance. The data collected tallies with what was studied by Kumar, (2022) that micro Science kits are not contributing much to the development of specific manipulative skills and techniques related to the use and handling of traditional macro science kits for example the use of a triple beam balance.

A teacher at Mukwengure said, *“The kits may cover a narrow range of topics, limiting the exposure of learners to broader concepts in biology.”* Kumar, (2022) noted the same weakness. Having noted that, the researcher believes that macro kits are critical.

The use of micro science kits often involves technical equipment and procedures, such as micropipettes and micro plate assays. Research reveals that educators and students may face challenges in mastering the technical aspects of using these tools effectively, which can impact the successful implementation of experiments and activities. This finding supported Talanquer, Robertson, Bryan and Horan, (2021). The authorities came up with the same information in their research.

4. 3. Summary

The chapter looked at the presentation, analysis and discussions of data collected by the researcher. It focused mainly on the benefits and challenges of using micro-science kits in the teaching and learning of biology at O level. It was made clear, through the findings, that micro-science kits improve learners' comprehension of concepts. Revealed also is that, they are safe to use when compared with the traditional large apparatus which pose dangers to learners during use, due to their larger size. The costs of acquiring the kits are very low and manageable, when compared with macro-science kits. This, therefore, means that the micro kits are affordable. In biology lessons where kits are used, there is great enjoyment among learners since the small apparatus are easy to handle. Another discovery made was that, schools have inadequate apparatus which makes learners unable to use them during lessons. Challenges like scarcity of the kits in some cases, lack of knowhow on the part of both teachers and learners would leave the apparatus serving no intended use. In chapter 5, recommendations and conclusions based on research findings will be done.

CHAPTER 5. SUMMARY, CONCLUSIONS AND RECOMMENDATIONS.

5. 0. Introduction.

This chapter dwells on the summary of the whole research process, focusing on major highlights of the chapter me to Chapter 4. This it gives a general overview of the research problem, review of the related literature on the topic: An investigation into the benefits and challenges of utilizing the micro science kits on learning and teaching of Biology. The chapter also gives highlights of the research design that was employed and key findings of the study. Therefore, conclusions based on the discussion of the findings presented in chapter 4 are provided .The chapter also proffers a presentation of research recommendations in relation to discussion and findings in chapter.

5. 1. Summary of the research.

Chapter 1 focused on the problem, its setting and also outlining the objectives of the research which sought to answer. The study aimed at bringing about the benefits of using micro science kits in teaching and learning of Biology as well as the challenges that maybe encountered when using these kits. 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 which was qualitative. It employed observations, unstructured in-depth interviews and FGDs as research instruments. In chapter 4 of the study, a presentation and discussion of research findings was done. 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 done but the researcher faced financial constraints for photocopying. There were incessant power cuts which became a disadvantage in the processing of the research project. The other issue was the problem of time since the researcher is an employee in the Ministry of Education; time was limited to concentrate more in the research than teaching learners.

5. 3. Conclusions

This study has provided valuable insights into the use of micro-science kits in the teaching and learning of biology. The findings demonstrate that when implemented effectively, micro-science kits can offer a range of benefits for both students and educators.

On the positive side, the kits were found to enhance student engagement and interest in biology by providing hands-on, interactive learning experiences. Students reported feeling more motivated and able to better visualize and understand complex biology concepts. Teachers also noted improvements in students' critical thinking and problem-solving skills as they worked through the kit-based activities.

However, the research also identified several challenges associated with the use of micro-science kits. Concerns were raised about the cost and accessibility of the kits, particularly for under-resourced schools. Additionally, some teachers expressed the need for more comprehensive training and support to confidently integrate the kits into their lesson plans.

Overall, the results suggest that micro-science kits hold significant potential to improve the teaching and learning of biology in secondary schools. However careful consideration must be given to addressing the logistical and pedagogical hurdles associated with the use of the kits. Further research is warranted to explore best practices for maximizing the benefits of these innovative learning tools. With the right implementation strategies and support structures in place, from the ministry and the government, micro-science kits could become a valuable complement to traditional biology teaching and learning.

5. 4. Recommendations.

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

- Educational institutions and curriculum developers should explore expanding the range of micro-science kit offerings across different biology subject areas.
- The integration of micro-science kits with digital learning resources, such as interactive simulations, virtual laboratories, and multimedia content, which can create a more immersive and holistic learning experience for students.

- Effective implementation of micro-science kits in biology classrooms requires comprehensive training and support to educators equipping them with the necessary skills and knowledge to effectively incorporate these kits into their teaching practices. Ongoing professional development opportunities can ensure that teachers remain up-to-date with the latest advancements in micro-science kit technology and pedagogical strategies.
- To maximize accessibility and affordability by exploring cost-effective procurement strategies, such as volume discounts or leasing programs, can make micro-science kits more accessible to educational institutions.
- Development of open-source or low-cost micro-science kit designs can further democratize access to these innovative learning tools.

5.5. Recommendations for future studies.

The researcher recommends that the study be carried out by looking at attributes which contributes to the improvement of results in Biology. Also another area is to look at learning of Biology for improvement in perform

APPENDICES

APPENDIX I

INTERVIEW GUIDE FOR LEARNERS

Introduction

Thank you for participating in this interview. You have been made part of my sample on my research study. Your insights as a student will help us understand challenges and benefits encountered when utilizing micro-science kits when compared with traditional macro-kits, in the teaching and learning of ordinary level biology. The information is for academic use and it will be confidential. Feel free to share your experiences and opinions.

1. What items are in your Science kits?
2. Have you benefited from the use of micro Science Kits?
3. What changes have you noted in your performance after using the micro science kits?
4. Was there any changes or difference in the pass rate before and after using the micro science kits?
5. What challenges are you facing with the use of micro science kits?
6. Are you enjoying the biology lesson done using the micro science kits?

Conclusion

Thank you for sharing your valuable insights and experiences. Your input will help us better understand benefits and challenges of using micro-science kits in ordinary level biology teaching and learning.

APPENDIX 11

INTERVIEW GUIDE FOR BIOLOGY TEACHERS

Introduction

Thank you for participating in this interview. You have been made part of my sample on my research study. Your insights as a biology teacher will help us understand challenges and benefits encountered when utilizing micro-science kits when compared with traditional macro-kits, in the teaching and learning of ordinary level biology. The information is for academic use and it will be confidential. Feel free to share your experiences and opinions.

1. How long have you been using the micro science kits?
2. Do you have adequate micro science kits for learners?
3. From your experience of teaching science during the past years, what changes have you noticed when Macro and Micro science kits were used?
4. What are the benefits of using the micro science kits?
5. From the observation you have made .What can you say about the utilization of micro science kits in schools?
6. Are you enjoying teaching Biology using micro science kits?
7. Have you found yourself and learners adapting to the new experience of learning biology using micro science kits?
- 8 .What challenges are you facing in using micro science kits?
9. How does the use of micro science kits affected learners?

Conclusion

Thank you for sharing your valuable insights and experiences. Your input will help us better understand benefits and challenges of using micro-science kits in ordinary level biology teaching and learning.

APPENDIX III

FOCUS GROUP DISCUSSION FOR LEARNERS.

Introduction

Thank you for participating in this focus group discussion. Your insights as a biology learner will help us understand challenges and benefits of utilizing micro-science kits when compared with traditional macro-kits, in the teaching and learning of ordinary level biology. Feel free to share your experiences and opinions as they private and confidential.

1. What items are there in your micro science kits?
2. Have you benefited from the use of micro science Kits?
3. Do the use of micro science improve performance?
4. What challenges are you facing with the use of micro science kits?
5. Can the challenges be overcome?
- 6 .Are you enjoying the biology lesson done using the micro science kits?

Conclusion

Thank you for sharing your valuable insights and experiences. Your input will help us better understand benefits and challenges of using micro-science kits in ordinary level biology teaching and learning.

APPENDIX IV

OBSERVATION GUIDE

WHAT TO OBSERVE

Introduction

Thank you for participating in this observation guide. Your insights as learners and teacher will help us understand challenges and benefits of utilizing micro-science kits when compared with traditional macro-kits, in the teaching and learning of ordinary level biology. Feel free to share your experiences and opinions as they are private and confidential.

1. Learners micro science kits available at school.
2. Learners' ability to use micro science kits.
3. Learners quality of work.
4. Attitude of learners during lessons where micro science kits are in use.

Conclusion

Thank you for sharing your valuable insights and experiences. Your input will help us better understand benefits and challenges of using micro-science kits in ordinary level biology teaching and learning.

REFERENCES.

- Akpan, B., and Nwokah, E., (2023), micro-science kits in the teaching and learning of science: a review of literature. *Journal of Science Education and Technology*, 32(1), 45-60
- Brown, C., and Lee, S., (2019). Integrating micro science kits into the curriculum: a teacher perspective. *Journal of STEM Education*, 20(4), 439-451. <https://doi.org/10.jstem.2019.015>
- Brown, C., and Lee, S., (2018). The impact of micro science kits on student collaboration in biology. *Journal of STEM Education*, 21(1), 87-99. <https://doi.org/10.1007/jstem.2018.019>
- Chaudhary, A., and Kumar, S., (2022). Exploring the impact of micro science kits on student engagement: *Journal of Science Education*, 15(2), 89-104
- Chen, Y., Wang, B. (2020). Visualizing biology with micro science kits: *science Education*, 96(3), 312-325. <https://doi.org/1011002/sce.21532>
- Choi, S. and Lee, J. (2024). The long-term impact of hands-on learning in STEM education. *Journal of Science Education*, 15(2), 89-104.
- Ganske, k. (2018). Micro science kits in the classroom: challenges and opportunities. : *Journal of Science Education and Technology*, 27(3).312-325. <https://doi.org/10.1007/s10956-018-9726-5>
- Garcia, M., and Martinez, S, (2019). Fostering inquiry-based learning with micro-science kits in biology. *Journal of Science Education and Technology*, 28(4).521-533.<https://doi.org/10.1007/s10956-019-09876-4>.
- <https://doi.org/10.1002/sce.21532>
- Jang, H. and Park, S. (2023). Affordable and accessible science kits for underserved communities. *International Journal of Science Education*, 20(1), 45-62.
- Johnson, R., and Smith, L., (2017). Enhancing biology education through micro science kits. *International journal of Science Education*, 51(2) 189-202.
- Lee, M. and Kim, S. (2023). Blending physical and virtual experiences in science education. *Computers and Education*, 85, 112-128.

Nguyen, T, and Tran, L. (2023). Diversifying instructional approaches in biology classrooms. *The American Biology Teacher*, 85(3), 167-174.

[oi.org/10.1080/00219266.2016.1243119](https://doi.org/10.1080/00219266.2016.1243119)

Sassower, R, (2017). Casualty and correlation in B.S.Turner (Ed). *The wiley black well Encyclopedia of social theory*. New York, NY, Wily.

Smith, A., and Johnson, T. (2020). Overcoming barriers to micro-science kit implementation in secondary education. *Science education*, 94(2), 201-215.

Smith, J, and Lim, A. (2024). Micro-scale experimentation and student engagement in secondary science. *Journal of Chemical Education*, 101(2), 123-134.

Smith, J., and Jones, K., (2021). The impacts of hands-on learning tools on student engagement and conceptual understanding in science education. *International journal of science Education*, 18(2), 123-138.

Teddie, C., Johnson, R., B., (2016). *Methodical thought before the 20th century. Intergration quantitative and qualitative approach in the social and behavioral sciences*, 47, thousand, CA: sage.

Vogt, W., Gardner, D., C., and Haeffele, L., (2015). *When to use research design*, 1st Edition. New York. The Gulford Press.

Wilson, E. and Nguyen, T. (2024). Professional development for technology-enhanced science teaching. *Contemporary Issues in Technology and Teacher Education*, 24(1), 45-60.