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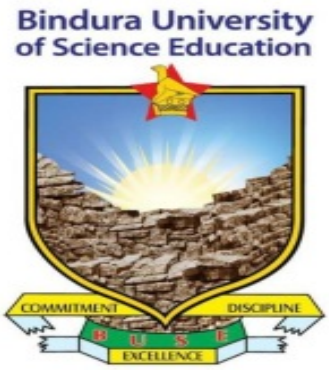
I  **S DEGREE IN**

AN INVESTIGATION INTO THE EFFECTS OF EXPERIMENTATION AS A METHOD OF EXAMINING CANDIDATES IN BIOLOGY AT O LEVEL: A CASE FOR GUTU SCHOOLS.

BY

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A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF THE BACHELOR OF SCIENCE HONORS DEGREE IN BIOLOGY

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Title of the Project: An investigation into the effects of experimentation as a method of examining candidates in Biology at O level: A case for Gutu schools.

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   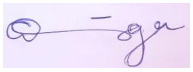

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   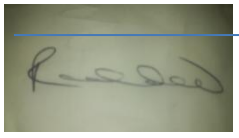

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   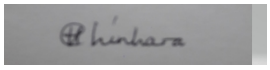

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DEDICATION

This study is dedicated to my mother Mrs A. Chisvinga who encouraged me through all circumstances to reach beyond the stars I am so thankful. To my son and daughter Royal and Destiny Masomera you are the reason I have so much courage to move on when the road gets tough. To my uncle and wife Mr and Mrs Tagutanazvo I am thankful for all the encouragement and support you have given me.

ABSTRACT

The assessment of candidates in the field of education has always been a topic of interest for researchers and educators. In the context of science education, the assessment of practical skills and hands-on experimentation is of utmost importance. O level Biology, an internationally recognized secondary level qualification, puts a significant emphasis on practical skills and experimental knowledge.

The assessment methods used in O level Biology vary across different educational systems, but often include practical examinations to evaluate candidates' ability to conduct experiments, record observations, analyze data, and draw conclusions. However, the efficacy and fairness of such assessment methods have been questioned over the years. Some argue that traditional examination-based assessments fail to accurately reflect students' practical skills and level of understanding. Against this background, research studies have explored alternative methods of assessing candidates in O Level Biology, other than experimentation as an assessment tool. This research investigates the effects of experimentation as a method of examining candidates in Biology at O level.

Despite the potential benefits of experimentation as a method of assessing learning, there are significant gaps in its implementation within biology education at O level. Many biology curricula and assessments in secondary schools often prioritize theoretical knowledge over practical application. Consequently, students may struggle to understand how biological concepts relate to real-world situations, limiting their ability to apply their knowledge effectively.

Moreover, there is limited research on the effectiveness of experimentation as an assessment tool in O level biology. Current literature focuses mainly on its benefits for research purposes in higher education or scientific careers, rather than its impact on learning outcomes among secondary school students. As a result, there is a need to bridge this knowledge gap and explore the effects of experimentation in assessing learning at O level.

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CHAPTER 1: INTRODUCTION

1.0INTRODUCTION

This chapter presents the general introduction of the study. The study is on the effects of experimentation as a method of examining candidates in Biology at O level in Gutu district Zimbabwe. Studies have shown that little is being done in schools in integrating experiments as tools for assessment due to a good number of factors. In this chapter the researcher is going to focus on the background to the study, statement of the problem, the major research question, research sub questions, research objectives, significance of the study, assumptions of the study, delimitations, as well as limitations of the study. Key terms will also be defined in this chapter.

1.1 BACKGROUND TO THE STUDY

The scrutiny of learner evaluation within the educational sphere has perennially captivated the attention of scholars. Within the realm of scientific pedagogy, the appraisal of hands-on experimental competencies is deemed paramount. The O level Biology curriculum, a globally acknowledged academic credential at the secondary tier, underscores the importance of such practical abilities and empirical acumen.

The assessment methods used in O level Biology vary across different educational systems, but often include practical examinations to evaluate candidates' ability to conduct experiments, record observations, analyze data, and draw conclusions. However, the efficacy and fairness of such assessment methods have been questioned over the years. Some argue that traditional examination-based assessments fail to accurately reflect students' practical skills and level of concept mastery. Against this background, most research studies have explored alternative methods of assessing candidates in O level Biology, other than experimentation as an assessment tool. This study focuses on investigating the effects of experimentation as a method of assessing candidates in Biology at O level.

In their 2017 study, Smith, Jonson, and Brown scrutinized the ramifications of integrating experimental assessments within the O level Biology curriculum. They contrasted the academic outcomes of students assessed via conventional exams against those evaluated through experimental means. The findings revealed that the latter group exhibited superior practical capabilities and a more profound grasp of scientific principles.

Johnson and Brown's 2015 research delved into the attitudes and experiences of O level Biology educators concerning experimental assessments. The outcomes underscored the educators' perception of such evaluations as more genuine and congruent with the practices of the scientific

community. Furthermore, educators noted enhancements in the students' analytical and problem-solving faculties attributable to experimental assessments.

A 2018 case study by Turner and Anderson centered on an educational institution that embraced experimentation as the chief evaluative method for its O level Biology students. Data was amassed via interviews, observational studies, and academic records. The findings suggested that experimental assessments bolstered student engagement, motivation, and retention of scientific knowledge.

Biology, the scientific study of life and living entities, is pivotal for deciphering the intricate processes within organisms and their environmental interactions. Biology education endeavors to endow students with the requisite insights and competencies for scientific comprehension and reasoning.

A key component of biology education is the evaluation of student learning outcomes. Traditional biology assessments have predominantly relied on written examinations, which often emphasize rote learning over conceptual understanding. Emerging research advocates that such examinations fall short in capturing students' grasp of biological theories and their applicability in tangible contexts.

Experimentation as an evaluative method allows students to immerse themselves in scientific exploration, fostering analytical and problem-solving aptitudes. Through the design, execution, and analysis of experiments, students gain experiential knowledge of biology's practical applications. This approach also promotes the cultivation of laboratory techniques, data scrutiny, and communicative skills.

Despite its prospective advantages, the incorporation of experimentation in O level biology education remains insufficiently realized. Many secondary education curricula and assessments continue to favor theoretical knowledge at the expense of practical application, potentially hindering students' ability to relate biological theories to real-life phenomena and apply their understanding effectively.

Furthermore, research on the efficacy of experimentation as an assessment tool in O level biology is sparse. The prevailing literature tends to focus on its advantages for advanced education and

professional scientific pursuits rather than its influence on secondary education learning outcomes. This gap enhances further investigation into the impact of experimental assessments on O level learning.

Addressing these lacunae in biology education concerning experimental assessment is vital for pedagogical enhancement. The insights derived from this study enriches the existing corpus of knowledge, equipping educators and policymakers with the information needed to refine biology assessment strategies. The overarching goal is to augment students' comprehension of biological concepts, nurture scientific thinking, and equip them for future academic or professional endeavors in biology.

1.2 STATEMENT OF THE PROBLEM

There is great concern on the effects of experimentation as a method of assessment in Biology at O level, there is limited information on the impact of this assessment method. The present study is on the effectiveness experimentation as a method of assessment in O level Biology: A case for Gutu schools.

1.3 MAJOR RESEARCH QUESTION

How effective is the use of experimentation as a method of examining candidates in Biology at O level?

1.4 RESEARCH SUB- QUESTIONS

1.4.1 What is the benefit of incorporating experimentation as a method of examining candidates in Biology at O level?

1.4.2 What are challenges faced by teachers in using experimentation as a method of examining learners in Biology at O level?

1.4.3 What challenges learners face during experimentation based examinations in Biology at O level?

1.4.3 What is the impact of experimentation as a method of examining candidates in Biology at O level?

1.5 RESEARCH OBJECTIVES

The research seeks to:

- explore the benefits of using experimentation as a method of examining candidates in biology at O level.

- probe the challenges faced in the use of experimentation as a method of examining candidates in Biology at O level.

-explore the impacts of using experimentation as a method of examining candidates in Biology at O level.

-explore the role of experimentation in assessment of learners in Biology at O level.

1.6: SIGNIFICANCE OF THE STUDY

It is hoped that this study is going to:

- help school teachers and authorities to come up with guided policies on experimentation as an assessment tool in O level Biology.

- bring to the centre stage the challenges faced by teachers and learners using experimentation as a method of assessment in Biology.

- give a practical explanation of the dynamics that characterise experimentation, assessment and the understanding of Biology concepts.

- give a mirror-picture of some of the ways in which the assessment of learners in O level Biology can be improved using experimentation.

1.7: ASSUMPTIONS OF THE STUDY

The study is guided by the following assumptions:

_ there is an association between experimentation and examining of learners.

_there are other factors that affect experimentation and examinations.

_there is a bi-directional influence between experimentation and performance in examinations.

1.8: DELIMITATION

The study was undertaken in Gutu Central in Masvingo Province, 40 km from Mupandawana Growth Point area. The researcher included permanent teachers with a minimum of diploma in education.

1.9: LIMITATIONS

The researcher encountered several obstacles during the course of the study, primarily due to the constrained timeframe available for research, as the entire investigation was to be completed within a single semester. To mitigate this limitation, the researcher capitalized on vacation periods and leave days to conduct the necessary research activities.

Additionally, the researcher faced resistance from some educational institutions and instructors who were reluctant to participate and provide the required responses. To overcome this challenge, the researcher proactively established a rapport with potential participants, fostering a sense of collegiality. Adherence to ethical research standards was maintained throughout the process, which further facilitated cooperation.

The researcher's dual role as an educator within the same community as the participants proved advantageous. This existing professional relationship engendered a supportive environment, as the participants were more inclined to contribute to the research conducted by one of their peers. The familiarity and trust inherent in this relationship were instrumental in encouraging participation and ensuring the success of the study despite the aforementioned challenges.

1.10: DEFINITION OF TERMS

Experimentation

Stevens and Campbell (2017) defines experimentation as, “a research method used to establish cause-and-effect relationships through the manipulation of one or more independent variables and the measurement of their effect on one or more dependent variables.” This definition pinpoints the importance of experimentation as that of identifying casual relationships between variables through controlled manipulation and observation. Tochim (2006) defines experimentation as, “a method that involves testing nature under controlled conditions.” This definition emphasizes the controlled nature of experiments, where researchers aim to isolate and manipulate specific variables to understand their impact on outcomes.

Assessment

Suskie (2018) delineates assessment as a methodical procedure for collecting, analyzing, and interpreting data to gauge the degree to which students meet predetermined educational objectives. Bennet (2013) expands on this by asserting that within an academic context, assessment encompasses the act of monitoring learning, which involves the documentation, collection, recording, and analysis of information about a student's progress. This can be achieved through diverse methods such as interviews, observations, tests, projects, or other means of data collection.

Formative Assessment

Black and Wiliam (1998) describe formative assessment as the ongoing process of acquiring information about student learning throughout the educational experience. This approach aims to pinpoint areas needing enhancement and provide feedback that aids students in advancing toward their learning goals. Bennet (2013) suggests that formative assessment is often equated with

"assessment for learning" because it underscores the utilization of assessment as a mechanism to foster learning, rather than merely quantifying it.

Summative Assessment

Bloom, Hastings, and Madaus (1971) characterize summative assessment as the evaluation of student learning at the conclusion of an instructional unit or course. This evaluation is intended to ascertain the level of student achievement concerning the learning objectives set forth. Black and William (2009) concur, noting that summative assessment is the appraisal of student learning and accomplishments at the end of a defined instructional period—be it a unit, chapter, or semester—with the objective of assessing the student's overall comprehension, knowledge, and skills acquired during that time.

Examination

Ramsden (2023) defines an examination as a formalized method of assessing a student's knowledge, skills, or competencies in a specific field of study. Examinations can manifest in various formats, including written tests, oral evaluations, practical demonstrations, or a blend of these approaches.”

CHAPTER 2:

LITERATURE REVIEW

2.0: INTRODUCTION

This chapter reviews literature on the role of experimentation in O level Biology assessment. It will explore theoretical frameworks supporting experimentation in science education and examine

how combining experimentation with assessment could potentially improve Combined Science pass rates. The chapter will also discuss the benefits and challenges of using experimentation as an examination tool, as well as its overall impact on teaching and learning in Biology.

2.1 THEORITICAL FRAMEWORK

Discovery Learning Theory

Jerome Bruner, a distinguished American psychologist, introduced the concept of discovery learning in the 1960s. This educational theory posits that learners can effectively assimilate knowledge and comprehension through active exploration, inquiry, and problem-solving. This pedagogical approach stands in stark contrast to conventional educational methods that primarily involve the passive transfer of information to students. Bruner (1961) advocated that the objective of education should extend beyond the mere transmission of facts, aiming instead to cultivate a child's cognitive and analytical abilities, which can be applied across various contexts. Bruner's educational philosophy is particularly congruent with the practice of employing experimentation as a means of evaluating students in O-level Biology. It underscores the significance of active participation, constructivist learning, the Zone of Proximal Development, and social interaction, all of which can significantly enhance the efficacy of experimental examinations in fostering students' intellectual growth.

In his 1966 work, Bruner championed the idea that learners should be actively engaged in the discovery of principles and concepts on their own, rather than being recipients of pre-packaged information. He envisioned educators as facilitators and guides in the discovery journey. Within the realm of O-level Biology education, instructors are encouraged to design assessments that allow students to conceive, execute, and interpret their own experiments. Bruner also underscored

the value of intrinsic motivation, wherein learners are driven by the inherent interest and satisfaction derived from the learning activity itself, as opposed to external rewards or penalties.

Bruner (1966) also introduced the concept of a spiral curriculum, which revisits fundamental ideas at progressively more complex levels throughout the educational process. In the context of Biology education, this suggests that teachers should create assessments based on experimentation that build from basic to intricate concepts, rather than focusing solely on preparing students for examinations This approach enables learners to expand upon their existing knowledge and cultivate a more profound and comprehensive understanding. Bruner (1978) emphasized the importance of scaffolding, where educators provide incremental support to students as they tackle challenging tasks, gradually reducing assistance as the student's proficiency increases. However, schools in the Gutu district offering Biology often face challenges such as insufficient resources for experiment-based assessments. Consequently, teachers frequently demonstrate experiments, limiting students' opportunities for hands-on experience. Bruner (1960) highlighted the necessity of ensuring that students possess the requisite foundational knowledge and skills before introducing new, more complex material, to facilitate active engagement and comprehension of new content.

Bruner's Discovery Learning theory is deeply embedded in the tenets of active learning, constructivism, the Zone of Proximal Development (ZPD), and social interaction, all of which reflect the positive impact of experimental-based assessments on students' cognitive development. Bruner (1966) contended that learning is an active endeavor in which learners construct new ideas or concepts based on their existing knowledge.

Bruner (1966) posited that learners build knowledge through their experiences and interactions with their surroundings. In O-level Biology, experimentation as an examination method provides

a platform for active learning, allowing students to engage directly with biological concepts through hands-on experiments, thereby enhancing their understanding and cognitive development.

Grounded in the principles of constructivism, Bruner (1977) stated that individuals create their own understanding and knowledge of the world through experiences and reflection. The Discovery Learning theory emphasizes the learner's role in constructing their own understanding of biological concepts by developing hypotheses, designing experiments, and analysing results. This active knowledge construction fosters deeper learning and cognitive growth. Vygotsky (1978) described the ZPD as the gap between what a learner can achieve independently and what they can achieve with guidance from a more knowledgeable individual. This concept implies that learning is most effective within a challenge range that is appropriately difficult for the learner. Experimentation as an assessment method enables students to extend their limits and operate within their ZPD, applying theoretical knowledge to practical scenarios and bridging the gap between theory and real-world application.

Bruner (1985) highlighted the significance of social interaction in cognitive development, asserting that learning is inherently a social process. He believed that learning occurs through interactions with more knowledgeable others, such as teachers or peers, who can offer guidance and support. In Biology, experimentation-based assessments often involve collaborative work, where students can discuss, exchange ideas, and work together on experimental tasks. This social interaction promotes cognitive growth by exposing students to diverse viewpoints, facilitating the negotiation of meaning and encouraging cooperative problem-solving.

Experiential learning theory

The Experiential Learning Theory was developed by David A Kolb in the 1970’s. This theory proposes that learning occurs through a continuous process that involves experiencing, reflecting,

thinking and then taking action. According to Kolb (1984), individuals acquire and transform knowledge through direct experience, reflection on that experience, forming abstract concepts and then testing those concepts in new situations. In the context of O-level Biology exams, the use of experimentation as a method of examining candidates aligns well with the principles of the Experiential Learning Theory. Experimentation allows students to engage in concrete experiences where they actively manipulate variables and observe the outcomes. This concrete experience then leads to a phase of reflective observation where the students analyse their findings and make sense of the underlying concepts.

The Experiential Learning Theory (ELT) cycle consists of four stages namely concrete experience, forming abstract concepts and then testing those concepts in new situations. Kolb (1984) indicates that the learning process begins with a concrete experience, at this stage the learner actively engages in an experience or task. They immerse themselves in the activity and observe the results. In the context of this research, the concrete experience would be the students' direct involvement in the experimental activities during the O-Level studies. The students would engage in hands-on experiments, observations and practical applications of biological concepts. The concrete experience stage allows the students to have a tangible, first-hand experience with the subject matter.

According to Kolb (1984), the concrete experience stage is followed by a phase of reflective observation, where the learner reflects on and examines the experience from various perspectives. This stage applies to the effects of experimentation as an assessment tool in O level Biology in the sense that, after the concrete experience of conducting experiments, the students would reflect on their observations, findings and the overall process. They would consider the challenges faced, the insights gained and the implications of the experimental results. The reflective observation stage

encourages students to critically analyse their experiences and develop a deeper understanding of the subject matter (Kolb and Kolb 2005).

Kolb and Kolb (2005) indicate that the stage of abstract conceptualization involves the students formulating theories and generalizations to explain observed phenomena. This stage aligns well with the research being under taken in the sense that, during this stage the students would attempt to formulate theories, principles or generalizations based on their reflections and observations. They would try to connect the broader conceptual frameworks in Biology, aiming to develop a more comprehensive understanding of the subject.

According to Kolb (1984) the final stage of the ELT is the active experimentation where the leaner finally applies new understanding to plan on how will they handle similar situations in the future. They test their ideas and theories through active experimentation. In the context of this research the active experimentation stage would involve the students applying their newly acquired knowledge and insights to design, conduct and evaluate further experiments. The active experimentation stage allows students to test their hypothesis, refine their experimental methods and continue to expand their understanding of the subject matter (Svinick and Dickson 1984).

Incorporating experimentation as a method of examining candidates in Biology at O-Level can effectively capture the students' ability to engage in the cyclical learning process. Watermeyer (2012) indicates that, through hands-on experiments, students can demonstrate their understanding of Biological concepts, their ability to design and execute scientific investigations and their capacity to analyse and interpret data.

Moreover, the use of experimentation in assessment aligns with the broader emphasis on developing practical skills and scientific inquiry in the O-level Biology curriculum. This approach

not only evaluates students' factual knowledge but in real- world problem solving contexts (Ministry of Education 2023).

All in all the ELT provide a strong theoretical foundation for the use of experimentation as a method of examining candidates in Biology at O-level. Engaging students in the full cycle of the stages of the ELT can effectively assess their comprehension of biological principles and their ability to apply scientific reasoning. The four stages of the theory provide a framework to assess the impact of hands-on experiential learning on the students.

2.3 Experimentation

Experimentation often refers to the process of conducting systematic tests or trials in order to discover, demonstrate, or validate scientific theories, hypotheses, or principles. Stevens and Campbell (2017) define experimentation as "a research method used to establish cause-and-effect relationships through the manipulation of one or more independent variables and the measurement of their effect on one or more dependent variables." This definition underscores the importance of identifying causal relationships between variables through controlled manipulation and observation. Trochim (2006) describes experimentation as a method that involves "testing nature under controlled conditions." This definition emphasizes the controlled nature of experiments, where researchers aim to isolate and manipulate specific variables to understand their impact on outcomes. Experimentation plays a crucial role in advancing scientific knowledge and understanding by providing empirical evidence to support or refute hypotheses. By following rigorous procedures and methodologies, researchers can uncover new insights and contribute to the body of knowledge within their respective fields.

2.4 Examination

Examinations at the secondary school level play a crucial role in assessing students' academic progress and performance. They provide a standardized method for evaluating students' understanding of the subjects they study and help teachers identify areas where additional support

may be needed. Barton and Collins (1997) argue that one type of examination commonly used at the secondary school level is the traditional written examination. These exams typically consist of a series of questions or prompts that students must answer within a set time frame. The questions are designed to test students' knowledge and understanding of the subject matter, as well as their ability to apply theoretical concepts to practical situations.

Examinations at the secondary school level may also include oral or verbal assessments. These assessments typically involve students presenting their knowledge or ideas in a spoken format, such as delivering a speech, participating in a debate, or engaging in a one-on-one discussion with a teacher or examiner.

The Ministry of Primary and Secondary Education (2021) O level Biology syllabus includes a practical examination component which aims to assess students' practical skills and knowledge in biological concepts and techniques. This practical examination is an essential part of the overall assessment process and aims to evaluate students' ability to apply their theoretical understanding of biology in a practical setting. It also helps to develop students' scientific inquiry skills, critical thinking, and problem-solving abilities. The practical examination in O level Biology in Zimbabwe usually consists of a series of experiments or investigations that students need to perform and report on. These experiments cover various topics such as physiology, biochemistry, ecology, and genetics. The experiments are designed to cover a range of skills, including data collection, analysis, interpretation, and drawing conclusions.

The Ministry Of Primary and Secondary Education (2021) O level Biology syllabus states that, one of the objectives of the practical examination is to assess students' ability to design and carry out experiments effectively. For example, students might be required to investigate a specific factor's effect on the rate of an enzymatic reaction. These experiments are carefully designed to test specific practical skills and biological principles that are outlined in the syllabus. The practical examination in Zimbabwean O level Biology typically involves a combination of hands-on experimental work in a laboratory setting and written reports. According to the Zimbabwe School Examination Council (2021), students are required to record their observations, measurements,

and data accurately during the experiment. After completing the practical work, students write a report summarizing their findings, analyzing the data, and discussing their conclusions, as well as any limitations or sources of error in their experiments.

2.5 ASSESSMENT

Assessment in education refers to the process of collecting, analyzing, and interpreting data to evaluate student learning outcomes, instructional effectiveness, and program effectiveness. It involves gathering evidence of students' knowledge, skills, and understanding through various methods and tools, such as tests, quizzes, assignments, projects, observations, and interviews. The purpose of assessment in education is to provide teachers and educational institutions with valuable information to make informed decisions about teaching and learning strategies, curriculum development, and instructional improvements.

Popham (2008) propounds that assessment is a critical component of the educational process and should be carried out in a fair and reliable manner. It should focus on assessing authentic and meaningful tasks, as well as addressing the different levels of cognitive complexity. This ensures that assessment accurately reflects students' abilities and promotes higher-order thinking skills. Additionally, assessment provides feedback to students about their progress and areas of improvement, which motivates and drives their learning. Black and Wiliam (1998) emphasize the importance of formative assessment in education. They argue that formative assessment, which involves providing ongoing feedback to students, plays a significant role in enhancing learning and achievement. According to their research, students who receive frequent, specific, and constructive feedback are more likely to improve their performance. They also propose that

teachers should use assessment as a tool for informing their instructional decisions and adapting their teaching practices to meet students' needs.

Another important aspect of assessment in education is its role in promoting equity and inclusivity. The National Council on Measurement in Education (2014) states that assessment should be fair and free from bias to ensure that students from all backgrounds have equal opportunities to demonstrate their learning. It is essential to use culturally responsive and authentic assessments that consider students' diverse experiences, backgrounds, and abilities.

Formative assessment

Formative assessment refers to the ongoing process of evaluating student learning and progress during instruction. It is a vital component of effective teaching and learning, as it provides valuable insights into students' understanding and allows educators to adjust their instructional strategies accordingly. Formative assessment is distinct from summative assessment, which is used to evaluate student learning at the end of a unit or course.

Assessment Reform Group (2002) asserts that formative assessment is "the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there." This definition highlights the key aspects of formative assessment: it is an ongoing process, it involves gathering and interpreting evidence of student learning, and it is used to guide both learners and teachers in the learning process. Black and Williams (1998) posits that the primary purpose of formative assessment is to inform teaching and learning by helping both teachers and students gauge their understanding and adjust instructional strategies accordingly. It involves a variety of methods, such as quizzes, class discussions, observations, projects, and self-assessments. These assessments can be formal or informal, and they provide valuable insights into students' comprehension, misconceptions, and areas that require further instruction. William (2011) postulates that, formative assessment fosters active student engagement, as it encourages learners to reflect on their own progress and make

adjustments to enhance their learning. It also helps teachers tailor their instructional approaches, address individual student needs, and provide timely and specific feedback to guide students toward mastery. By integrating formative assessment into the teaching and learning process, educators can create a more dynamic and responsive educational environment that supports continuous improvement.

Summative assessment

Popham (2014) says summative assessment refers to the evaluation of student learning and performance at the end of an instructional unit or period with the primary purpose of determining the extent to which intended learning outcomes have been achieved. Examples of summative assessment methods in the Zimbabwean O level Biology curriculum are end-o-term tests and public examinations that are provided by ZIMSEC.

Summative assessments such as test, projects and performance-based tasks are used to measure and quantify the knowledge, skills and understanding that students have acquired over a particular period of time (Dickson and Worrell 2016). In Zimbabwe candidates are supposed to sit for an experimentation-based assessment as part of their final examination in O level Biology. Guskey (2003) argues that the data gathered from summative assessments can help educators and administrators to evaluate the effectiveness of the instructional strategies, curriculum and resources used during the learning process. The researcher being a teacher at a school where Biology is offered noted that the school does not take the incorporation of experimentation-based assessments seriously during the course of the learning period. Experimentation-based assessments are rarely administered as part of the end of term examination; the actual situation is that the school procures materials and equipment only for the ZIMSEC final examinations. Popham (2014) explains that, summative results can be used to make decisions about student promotion, placement or the need for additional support or intervention.

Dickson and Worrell (2016) explain that summative assessments are often used to demonstrate student learning and achievement to external stakeholders such as parents, school boards and policy makers. Summative assessment in most Zimbabwean schools is implemented at end the end of every term of academic year and result are typically reported as grades or scores. This study seeks to shed light on the idea that summative assessments should be aligned with intended

learning outcomes and should be used in conjunction with formative assessments which focuses on on-going feedback and adjustment during the learning process.

2.6 Benefits of incorporating experimentation as assessment

Experimentation plays a crucial role in Biology at secondary school level. Tsakeni (2018) is of the opinion that the goals of practical work are to improve students understanding, develop their skills in solving problems and understanding the nature of science by replicating the actions of scientists. Incorporating experimentation as assessment in Biology at O level helps students to validate and apply the concepts they learn as it provides a hands-on experience to reinforce the theoretical knowledge they gain from textbooks. According to Millar (2004), practical work allows students to directly experience and interact with scientific phenomena, which can help them better understand and retain the underlying principles. This aligns well with the idea of experiential learning where students learn by doing rather than solely through passive instruction. Hirca (2013) highlights that, practical work can motivate, stimulate the interests of students in learning scientific concepts and widen their way of thinking.

Experimentation requires students to develop critical thinking skills by formulating hypotheses, designing experimental procedures and analysing results. Kirschner (1992) emphasizes that, experiments allow students to develop important academic skills beyond just concept knowledge. The skills include critical thinking, problem solving, data analysis and the ability to design and evaluate experimental procedures. The researcher noted that schools that offer Biology in Gutu District do not take into consideration the effects of incorporating experimentation as a method of assessing learners during the course of the learning period; their assumption is that experimentation is only essential in final examinations hence resources are not provided.

Students develop various skills through experimentation. Kirschner (1992) postulates that experiments are not just means to confirm pre-existing theories, but active tools for students to engage with the process of scientific inquiry, formulating hypotheses, designing studies, interpreting data and refining their understanding through an iterative process. According to Millar (2004), practical work allows students to develop a range of practical skills such as use of scientific equipment, data collection, analysis and the interpretation of results. Experimentation allows students to explore the practical applications of Biology in the real world. Students can investigate topics like environmental issues, genetics, health and Biotechnology, further connecting classroom knowledge with the outside world. Hofstein and Lunneta (2004) highlights tha,t the laboratory provides an opportunity for students to observe measure and collect data which can be analysed to construct explanations and draw conclusions.

The hands-on nature of experiments promotes curiosity and inquiry among students. It stimulates their interest in Biology and encourages them to explore, ask questions and seek answers thus fostering a lifelong interest in scientific exploration and discovery. According to Millar (2004) practical activities can increase student motivation and engagement in science by making learning experience more interactive, enjoyable and relevant to their lives. Experiments provide students with a deeper understanding of biological concepts and principles. They can witness phenomena first hand and experience cause-and-effect relationships, leading to a more comprehensive understanding of the subject matter. Abrahams and Reiss (2012) indicates that hands-on activities can facilitate the development of conceptual understanding by enabling students to observe, manipulate and make sense of scientific concepts in a tangible way.

2.7 Challenges faced by teachers when incorporating experimentation as a method of assessment

Incorporating experimentation-based assessments for O level learners in Biology presents several challenges for Biology teachers. Downie, Daly and Braund (2019) postulates that schools in low income areas struggle with limited access to laboratory resources hindering their ability to implement practical assessments effectively. Conducting experiments requires adequate equipment, materials and facilities. However many schools, especially those in developing countries may have limited resources, making it challenging for Biology teachers to design and implement hands-on experiments for O level learners. Argarwal and Ohri (2018) say that, "Schools in resource-constrained settings often struggle to provide the necessary materials and equipment for hands-on experiments." Lack of proper laboratory facilities and necessary equipment hinders the practicality of experimentation-based assessments.

Biology teachers often have limited amount of time to cover the extensive syllabus requirements for O level Biology. According to Linn (2005), the curriculum and syllabus requirements can be demanding, leaving limited time for conducting experiments. Incorporating experimentation-based assessments can be time-consuming as it requires additional preparation time for setting up experiments, conducting them and evaluating the results. Abraham and Reiss (2012) postulates that, the education system is examination-oriented hence little time is left for teachers to engage in practical work with students. Consequently teachers may feel pressured to prioritize content delivery over practical assessments. Effective implementation of experimentation as an assessment method depends on the teachers' knowledge or expertise in conducting experiments and guiding students. Mirjana, Stango and Branko (2019) indicates that some teachers may lack the necessary training in experimental techniques or struggle to integrate practical work into their teaching due to limited professional development. Many science classes have large student populations which can make it challenging for teachers to provide individual attention and supervision during

practical assessments. Fadzil and Saat (2013) points out that, in such cases students may not receive sufficient guidance or have opportunities to actively participate in experimentation activities which can hinder their learning outcomes.

Carrying out experiments involves some level of risk, with potential hazards associated with handling chemicals, using laboratory equipment or working in specific environments. According to Abrahams and Reiss (2012), ensuring that students are safe is of great concern for Biology teachers. Ensuring students' safety is of utmost importance and Biology teachers need to be aware of potential risks and take necessary safety precautions. Addressing safety concerns can be challenging, especially when there is a lack of proper safety equipment and training.

Experimentation-based assessments require accurate recording and analysis of data. However biology teachers may face challenges in ensuring consistency in data collection and interpretation among O level learners. Agarwal and Ohri (2018) indicate that, inconsistencies in assessment of results emanates from students failing to accurately record and analyse data. This challenge emanates from large class sizes which are difficult to manage. Students may struggle with accurate measurement recording observations or analysing data, leading to variability in the quality and reliability of their results. It becomes very difficult for the teacher to attend individual students who might need help because the class might too large.

According to Abrahams and Reiss (2012), Biology teachers may lack sufficient training and expertise in designing and implementing experimentation-based assessments. Experimentation requires a good understanding of experimental design, data analysis techniques and the ability to guide students effectively. Inadequate teacher training hinders the effective integration of practical assessments into the curriculum.

2.8 Challenges faced by candidates during experimentation-based examinations

Experimentation-based examinations pose unique challenges for candidates, requiring them to demonstrate practical skills, critical thinking and problem solving abilities. These challenges can be attributed several factors, including limited time, resource constrains, unpredictable outcomes and the pressure to perform under examination conditions. Smith, Jones and Callies (2012) postulates that, many students lack hands-on experience with scientific equipment and instruments due to limited access to well-equipped laboratories in their schools. This can lead to difficulties in setting up experiments, taking accurate measurements and troubleshooting problems during the practical examination (Akanbi and Kolawole 2014).

Experimentation-based examinations often have time constrains, forcing candidates to complete tasks within a specified period. Abrahams and Millar (2008) propounds that practical examinations are often time-constrained and students may struggle to complete all required tasks within the allotted time. This restriction can hinder candidates from fully exploring experimental procedures or conducting multiple trials to obtain optimal results. Osborne, Simon and Collins (2003) proposes that time constrains can lead to rushed work, mistakes and lack of attention to detail, which can negatively impact their performance. A study by Eccles, Mc-Elhinney and Hendry (2016) found that time limitations in practical examinations can hinder candidates' ability to engage in essential steps of the experimental process, compromise data collection, and limit the breath of analysis and interpretation. This is typical of the scenario in the Zimbabwean O level Biology curriculum in which candidates are only given one and half hours to do experiments, record their findings and draw conclusions. The researcher's opinion is that time allocated for the O level Biology practical examination is not enough, what she actually observed while invigilating

is that most candidates not have time to conduct multiple trails in order for them to obtain optimal results. Also candidates fail to finish the examination.

According to Lunneta, Hofstein and Clough (2007), practical examinations often require strong conceptual understanding of the underlying scientific principles and theories. Ding and Beichner (2009) indicates that students who solely rely on memorisation of facts and procedures may have difficulties in applying knowledge to novel situations or interpreting their observations during practical examinations. Accurate observation and recording of data are crucial in practical examination, but many students struggle with this skill. Abrahams and Millar (2008) indicates that factors such as poor eyesight, limited experience in making observations and difficulty in interpreting the significance of their observations can hinder the performance of some candidates during practical examinations.

Experimentation inherently involves uncertainties and candidates must navigate unpredictable outcomes during examination scenarios. Candidates may encounter unexpected variables, experimental errors or the need to deviate from the originally planned approach during practical examinations in Biology. These factors can challenge candidates' ability to adapt and think on their feet. According to Leach and Scott (2015), unexpected outcomes in experiments can introduce cognitive challenges, requiring candidates to analyse the situation, identify potential errors or variations and adjust their methodology accordingly. This adaptability is crucial as it demonstrates their ability to troubleshoot and respond effectively to uncertainties.

The examination environment adds an additional layer of pressure to candidates, which can impact their ability to perform effectively during experimentation-based assessments. Time constrains, expectations of accurate results and invigilators' presence may induce stress and performance anxiety. A study by Mulder, Weigand, Cho and Adam (2018) emphasized that performance

pressure during practical examinations affects candidates' motivation, confidence and overall performance. It can lead to reduced problem solving abilities and compromised decision-making skills

2.9 The impact of experimentation as a method of examining O level Biology candidates

Using experiments as a method examining O level Biology candidates has several impacts ranging from improved learning outcomes to the development of scientific skills and critical thinking abilities. Assigning experiments as part of the O level Biology examination enhances students' understanding of biological concepts and theory. A research conducted by Weinman, Perkins and Gilbert (2010) demonstrated that students who actively engage in experimental activities show significant gains in their understanding of scientific concepts. This can attribute to the hands-on nature of experiments, which allows students to apply their knowledge, visualize complex processes and reinforce important principles.

Experimentation-based examinations in O level Biology contribute to the acquisition and development of social scientific skills such as data analysis, research design and problem solving. According to Sundberg and Dini (1993), incorporating experiments as an evaluative tool in science education promotes development of scientific skills, enabling students to think critically and approach problems methodically. Experiments in science education provide students with the opportunity to apply theoretical knowledge in practical setting enhancing their understanding and retention of concepts. Cook, Campbell and Hawkridge (2013) postulates that students who engage in experiments as part of their learning and examination process demonstrate increased conceptual understanding and problem solving abilities.

Incorporating experiments into O level Biology examinations fosters scientific inquiry and curiosity among students. Students become more engaged and motivated to explore scientific

phenomena, leading to a deeper understanding of fundamental biological concepts. A research study by Ainely and Ainely (2011) indicated that students' curiosity and motivation were positively influenced by practical-based tasks, suggesting a positive correlation between curiosity and academic performance.

No gaps were identified.

2.10 SUMMARY

This chapter focuses on the review of literature related to the effects of experimentation as a method of examining learners in Biology at O level. The research explores on the Discovery Learning Theory and The Experiential Learning Theory and how they are related to the research under study. The researcher also identified the benefits of experimentation as an assessment tool, the challenges of experimentation as well as the impacts of experimentation as a method of examining candidates in Biology at O level.

CHAPTER 3:

RESEARCH METHODOLOGY

3.0: INTRODUCTION

The study was set to investigate the effects of experimentation as a method of examining candidates in Biology at O level in Gutu District. The following issues will be discussed in this chapter: research design, population, sampling procedure, instrumentation, triangulation, pilot study, validity and reliability, data collection procedures and presentation and analysis.

3.1: RESEARCH DESIGN

A research design is the strategy which the research follows in collecting, classifying and representing the information about a social phenomenon (Denzin and Lincolin, 2007). Research

designs can follow a quantitative or a qualitative design depending on the choice of the researcher. This study followed a qualitative researcher design. Tuckman (1994) explain that qualitative research is concerned with the developing explanations of social phenomena. It helps people to understand social events, relationships and situations. Hence, it calls for the researcher to be in contact with the events, relations and situations. Frankel and Wallen (1996) postulates that in qualitative, the researcher goes directly to the particular setting in which they are interested to observe and collect their data. Neuman (2000) add that a qualitative researcher seeks to analyze social phenomena in natural setting. Tuckman (1994) says that qualitative research is used to help the researcher to understand how people feel and why they feel in that way.

Denzin and Lincolin (2007) supports that qualitative research studies things in their natural settings, attempting to make sense of or interpret, phenomena in terms of the meanings people bring to them. The qualitative research design uses methods which provide a deeper understanding of phenomena. Creswell (1994) identifies the biography, phenomenology, grounded theory, ethnography and case study as the methods used in qualitative research. Lewis, Taylor and Gibbs (2010) say that, qualitative research gives a largely narrative description to the researcher's understanding of social phenomena. Hence, qualitative data is largely subjective with narratives from participants obtained using audio tapes, video tapes and field notes. However it brings the challenge of large volumes of data requiring the researcher's intelligence and acumen to present, interpret and analyze.

Miles and Huberman (2010) add that qualitative research provides a primarily inductive process of organizing data into categories and identifying relationships. Qualitative researcher deploy a wide range of interconnected interpretive practices, hoping to always get a better understanding

of the subject matter at hand (Chenail 1995). The qualitative research is meritorious in that it provides a deeper understanding in the area under study since the qualitative research design use interconnected interpretive practices, its advantages is that the world is understood from different ways (Denzin and Lincolin, 2007). According to Joubish, Khurram, Ahmed, Fatima and Heider (2011), qualitative inquiry is strong in using human insight and experience but its weakness is of being heavily dependent on the researcher's skill, training, intellect, discipline and creativity.

The researcher used a qualitative case study design which facilitated a thorough investigation into the issues affecting assessment at secondary school level. Tuckman (1994) say a case study is an in-depth study of phenomena in its natural setting. Bell (1994) quotes Bassey (1981:85) that, "If case studies are carried out systematically and critically, if they are relatable, and if by publication of the findings they extend the boundaries of existing knowledge, then they are valid forms of educational research." The case study allows a thorough investigation of a single case within a manageable time frame. Bell (1994) supports that, case study allows the researcher to concentrate on a specific instance or situation and to identify, the various interactive processes at work. Cohen, Manion and Morrison (2011) add that case studies collect data from a wider source .As a result, the data that is collected has depth about that case and can influence other researches. Bell (1994) explains that readability and depth of a single case study is more crucial than generalizability. The objective in a case study is not to generalize the findings but to have a deeper understanding of educational issues. Hence, the researcher can select an event, village, school cluster and study a certain phenomenon affecting the people in that setting. Bell (1994) explains that a successful case study provides the researcher with a three dimensional picture and illustrate relationships, micro-political issues and patterns of influences in a particular context. However, Bell (1994)

argues that there is a danger of distortion since it is difficult to cross-check information and the failure to generalize findings affect the quality of single events.

3.2: POPULATION

The population is the target group of the research which the research investigates. Frankel and Wallen (1996) say that a population is the group of interest to the researcher from which the researcher draws the sample. Borg, Gall and Gall (1996) say the target population includes all the members of a real population or hypothetical set of people, events or objects. All Biology teachers with a minimum of a diploma in education were the target population for this research. The researcher targeted schools which were within forty kilometers from Mupandawana Growth Point. The researcher sought narratives from Biology teachers who are daily in contact with the learners.

3.3: SAMPLE

Cohen, Manion and Morrison (2011) define a sample as a small group or subset of the total population in such a way that the knowledge gained is representative of the total population. Frankel and Wallen (1996) define a sample as any group on which information is obtained. The researcher managed to get in touch with five Biology teachers and five Heads of Science Department (HODs) from five different schools and they were the once who participated in this research. The study is a qualitative study hence its main focus was to find depth in the subject matter at hand therefore a small sample was manageable considering the timeframe used to do the research.

3.4: SAMPLING PROCEDURE

The researcher used purposive sampling to select Biology teachers and HODs from five different schools situated within forty kilometers from Mupandawana growth point to participate in this study. Cohen, Manion and Morrison (2011) say purposive sampling is handpicking of cases to be

included in the sample on the basis on the judgment of typicality or possession of the particular characteristics being sought. Bell (1994) says purposive sampling is used in intensive case studies to select participants who serve the purpose of the study. The researcher used convenience sampling method to select a manageable number of teachers who could participate in the research. The researcher worked with 10 teachers both male and female who were present at the schools and who were willing to participate in the research. Frankel and Wallen (1996) define convenience sample as a group of individuals who are conveniently available for study. Cohen, Manion and Morrison (2011) pinpoints that, convenience sampling is accidental or opportunistic sampling which involves choosing the nearest individuals to serve as respondents and continuing that process until the required sample size has been obtained or those who happen to be available and accessible at the time.

3.5: INSTRUMENTATION

The researcher used in-depth interviews, document analysis guide and observation check lists.

3.5.1: INDEPTH INTERVIEWS

The researcher used interviwed Biology teachers who were present using an interview guide. The responses of the Biology teachers who were present on the day of the interview were audio recorded and transcribed. Cohen, Manion and Morrison (2011) indicate that in- depth interviews are semi-structured and with open-ended questions that allow the researcher to tap into the respondents' subconscious mind. In-depth interview allows the researcher to probe further and ask the interviewee to explain further on issues and allows the interviewer to alter the sequence of questions.

3.5.2: QUESTIONNAIRE

The researcher used a questionnaire to gather information from Heads of Science departments who were present at the schools visited. Cohen, Manion and Morrison (2011) postulates that a questionnaire is a research instrument consisting of a series of questions or other prompts for the purpose of gathering information from participants. Bryman (2016) propounds that, questionnaires can include different types of questions such as closed ended (multiple- choice, likert scale) and open-ended questions depending on the research objectives and the type of research objectives and the type of information needed.

3.7: PILOT STUDY

A pilot study is the operationalization of the whole study to test the efficiency and feasibility of the research plan. Borg, Gall and Gall (1996) say a pilot study is a preliminary trial of research measures and techniques to develop a sound research plan where the entire research procedure is carried out, including analysis of the data collected, following closely the procedures planned for the main study. A pilot study is used to gather basic information about the topic before more imposing, precise and inflexible methods (Cohen, Manion and Morrison 2011). The researcher did a pilot study at Mutero High School which is near to her work place. The researcher then revisited the instruments which she planned to use and made some adjustments on the nature and number of questionnaire and interview question items to prepare. Borg, Gall and Gall (1996) supports that, a pilot study often provides approaches and clues unforeseen prior to the study and such ideas and clues greatly increase the chances of obtaining clear cut findings in the main study.

3.8 ETHICAL CONSIDERATIONS

Ethical considerations in research are vital in protecting research participants' well-being. It is crucial for a researcher to consider how she is going to safeguard the participants from abuse, harm, victimization, stereotyping and physical danger by participating in the research. In this research, confidentiality and informed consent are the main ethical considerations that were upheld. Miles and Huberman (1994) say informed consent is done to encourage free choice of participation where participants are informed about the time, place and duration of participation. The researcher explained the objective and purpose of the study so that the participants freely chose to participate. According to Bell (1994) confidentiality is the guarantee of privacy meaning withholding participants' real names and other identifying characteristics. Miles and Huberman (1994) say in upholding confidentiality, researchers have a dual responsibility that is protection of participants' confidences from other actors whose private information might enable them to identify them and protection of the informants from the general reading public. In this study the researcher used pseudo names, code school names into numbers and classes into numbers to ensure confidentiality.

3.9: RELIABILITY ISSUES

Neuman (2000) say reliability means dependability or consistency suggesting that the same thing is repeated or recurs under the identical or very similar conditions and the measurement should not yield erratic, unstable or inconsistent results. Tuckman (1994) explains that reliability entails consistency over time and internal consistency which means if the same instrument were given to the same people under the same conditions but at different time, to what extent would they get the same scores (test re-test reliability). Chenail (1995) say reliability is the extent to which other researchers would arrive at similar results if they studied the same case using exactly the same

procedures as the first researcher. Miles and Huberman (1994) say reliability in qualitative research refers to the consistency of the researcher's interactive style, data recording, data analysis and interpretations of participant meanings from the data. In this research, the researcher used verbatim accounts from audio recordings which she transcribed and used primary data which the researcher quoted in presenting the findings of the research.

3.10: DATA COLLECTION PROCEDURES

The researcher approached the Provincial Education Director to ask for permission to collect data from the schools in Gutu district. The Provincial Education Director gave the researcher a letter of approval which the researcher presented upon arrival at schools. The researcher conducted interviews with Biology teachers, while audio recording the responses. She went on to distribute questionnaires to HODs in the sciences departments. The researcher transcribed the contents of the audio recordings and also translated some of the responses that were done in Shona.

3.11: DATA PRESENTATION AND ANALYSIS

Data presentation is how the data is laid out so that it is clear and comprehensible. The data from interviews and questionnaires was presented in thematic form where the researcher selects themes and present, analyze and discuss the results under that theme. The researcher also used tables and pie charts to present the data.

Russell (2006) says that analysis is the search of patterns in data for ideas that help explain why those patterns are there in the first place. Qualitative data analysis is the range of processes and procedures whereby researchers move from the qualitative data that have been collected into some form of explanation, understanding or interpretation of the people and situations being investigated (Lewis, Taylor and Gibbs, 2010).The researcher coded the themes and juxtapose the data with related literature, the researcher's own descriptions, explanations, analysis and commentaries.

Lewis, Taylor and Gibbs (2010) say coding themes allows the researcher to quickly retrieve and collect together all the text and other data that they associated with some thematic idea so that they can be examined together and different cases can be compared in that respect. Chenail (1995) adds that juxtaposing increases the quality of the research where the data is analyzed by contrasting it with what has been previously said in the literature about similar data.

3.12: CHAPTER SUMMARY

The chapter focused on discussing the following issues, research design, population, sampling procedure, instrumentation, triangulation, pilot study, validity and reliability, data collection procedures, presentation and analysis.

CHAPTER 4:

DATA PRESENTATION AND ANALYSIS

INTRODUCTION

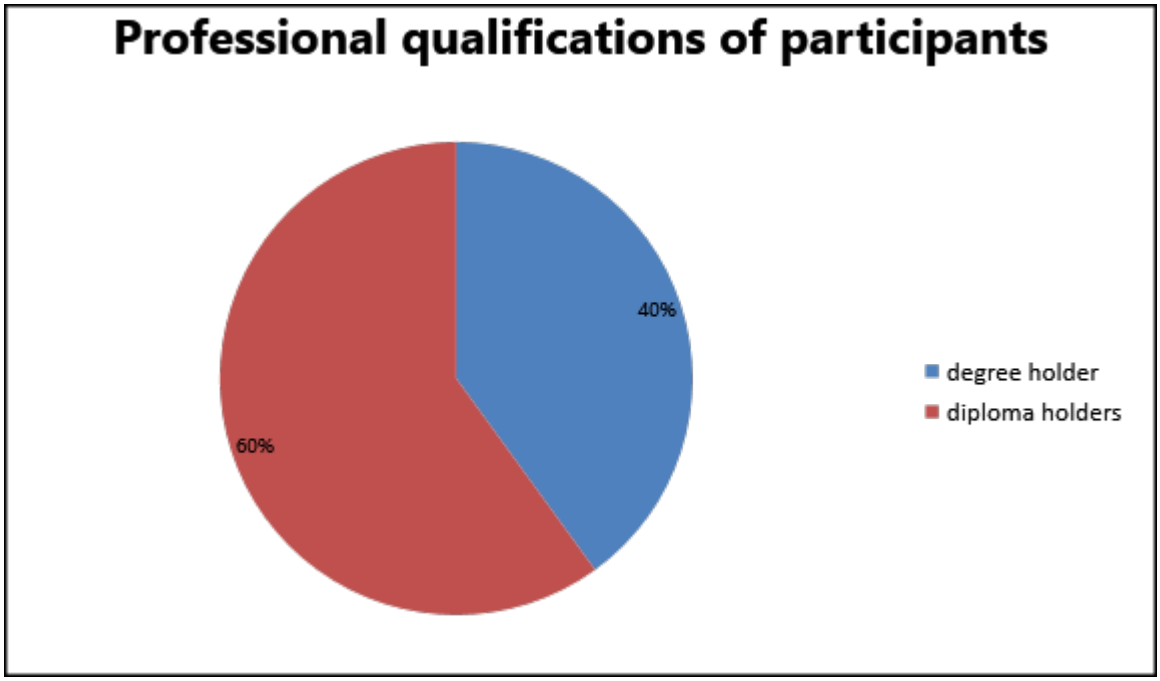
The study sought to investigate the effects of experimentation as a method of examining candidates in b Biology at O-level in Gutu District. The researcher used a qualitative data collection approach of using in-depth interviews with Biology teachers and questionnaires for Science Heads of Departments. The data collected was transcribed and presented using thematic content analysis. The data is juxtaposed with the researcher's argument and the views related literature.

4.1 DEMOGRAPHIC DATA

4.1.1 Table showing gender for research participants

Participants	**Male**	**females**	**Total**
HODs	3	2	5
Biology teachers	4	1	5

4.1.2 Pie chart showing professional qualifications of research participants



4.1.3 Table showing work experience for research participants

Less than 1 year	1-3 years	4-6 years	More than 10 years
1	3	1	5

DATA COLLECTED FROM INDEPTH INTERVIEWS

4.2.1 Methods of assessment used in Biology

The researcher interviewed five Biology teachers from different schools. On the assessment methods regularly used in Biology, all the participants concurred on using tests in form of structured questions, multiple choice questions presentations and practical tests during the course of the teaching period and at the end of every academic term. Mr Duck from school B said. “I use both summative and formative assessments when assessing learners in Biology.” Apple and Krumsieg (2008) highlighted that there are various types of assessment used in education which are formative, summative assessment and performance assessment. Bennet (2013) indicated

assessment within an academic setting can be done through interviews, observations, tests projects or any other information gathering method. The results show that methods of assessment are generally the same in O level Biology.

4.2.2 Utilization of experimentation as an assessment method

All the participants concurred that they have utilized experimentation as a method of assessment in form of structured questions, multiple choice questions, presentations, essays and at times practical test during the course of the teaching process. “I am very willing to utilize experiments when assessing learners but I often face challenges with the school administration because they rarely provide the department with enough materials to use during experiments”, said Mr. Frog from school A. Fadzil and Saat (2013) argued that although many teachers believe they can transform science teaching through experimentation, experimental activities are infrequent in schools due to lack of laboratory equipment and those which have them do not have the resources to maintain them. Mrs. Cat from school E said, “I always try to utilize experimentation as assessment but it is not an easy road because I plan but due to a number of constrains I end up failing to implement my plans.” Abrahams and Reiss (2012) conducted a study in England and their findings indicated that practical work is regularly conducted in both primary and secondary school Science classrooms in England. However the frequency and nature of practical activities varied significantly between different schools. Mr. Duck from school B said. “The syllabus is too long, packed with a lot of content that needs to be delivered to the learners so I do not have much time to do experimental work.” Linn (2005) found out that, the curriculum and syllabus requirements can be demanding, leaving limited time for conducting experiments. Results on utilization of experimentation as assessment show that teachers are willing to utilize experimentation as assessment but they are not getting enough support from school authorities.

4.2.3 Incorporation of experimentation in assessments

Mr Frog from school A said that, “For assessment I design an experiment with clearly defined objectives that I aim to assess. I also make sure that the experiment sure that the experiment aligns with the objectives so that I get relevant insights.” Linn (2005) points out that assessment is most useful when connected to some goal or objective for which it is designed for, tests yield information relative to an objective or goal. Mrs Impala from school C also said, “I try to give my students at most two practical tests per term but at times I fail to reach my target because materials for certain experiments will not be enough to cater for the whole class”. Other participants indicated that they include experimentation-based assessments in their schemes of work but only administer them when resources and time are available.

> Osborne (1993) argues that while practical work is often seen as a central and essential component of science teaching, it can be resource intensive, logistically challenging and might not always be the most effective approach for achieving intended outcomes. Results on the incorporation of experiments in assessments show that the incorporation of experimentation-based assessments in Biology is faced with challenges as a result candidates end up sitting for practical examinations without practicing much during the course of the teaching and learning period.

4.2.4 Assessment of learners’ practical skills

On the ways in which teachers assess the practical skills of their learners, Mr Dog from school D said. “I have designed an assessment guide which consists of components like proper use of equipment, participation when in groups, observation of safety protocols, data recording, presentation and the alignment of data collected with conclusions made.” The response above is just similar to responses from the rest of the participants who indicated that they have also designed assessment guides with various components in order to assess the practical skills of their learners.

The above findings reflects on how Biology teachers assess the practical skills of their learners using assessments guides to check for the attainment of various skills that learners should get through experimentation based assessments.

4.2.5 Benefits of experimentation in assessing learners in O level Biology

On the benefits of experimentation as a method of assessing learners in O level Biology all the participants concurred that experimentation enhances student engagement and interest in learning biology, it also promotes critical thinking and problem solving skills, fosters the development of practical skills such as measurement, data collection, presentation and analysis. Tsakeni (2018) highlighted that the goals of practical work are to improve students' understanding, develop their skills in solving problems and understanding, and develop their skills in solving problems and understanding the nature of science by replicating the actions of the scientists. Mrs Cat from school E opined experimentation as an assessment method helps in boosting learner's confidence in the sense that once the learners get positive feedback from their teacher on their success and failures during the practical test they become confident hence they become eager to carry out many more experiments. The opinions of the participants concur with the findings of the article by Hofstein and Lunneta (2004) found that the laboratory provides an opportunity for students to observe measure and collect data which can be analyzed to construct explanations and draw conclusions. Millar (2004) highlighted that, experimentation foster the development of practical skills such as proper use scientific equipment, techniques for data collection and analysis and safety protocols. Mr Duck from B said that, "Learners become motivated and they become more engaged when they carry out experiments." This concurs with the findings of Millar (2004) who indicates that practical activities can increase student motivation and engagement in science by making learning experience more interactive, enjoyable and relevant to their lives. Hirca (2013) highlights that,

practical work can motivate students stimulate their interests in learning of scientific concepts and widen their way of thinking. The views of the participants regarding the advantages of experimentation as a method of examining candidates in Biology reflects that experimentation increases students engagement and interest in Biology and it also improves skills in data collection, recording, presentation and drawing conclusions.

4.2.6 Challenges faced by teachers when implementing experimentation based assessments

Participants from all schools aired out the same views on the challenges they face when implementing experimentation-based assessments. Mr Dog from school D explained that there are challenges on time allocation, highlighting that Biology lessons are allocated time that is equal to all the other subjects in terms of minutes per lesson, this becomes problematic when experiment-based assessments are to be conducted because most of them require a more time for preparation and execution. Linn (2005) found out that, incorporating experimentation-based assessments can be time-consuming as it requires additional preparation time for setting up experiments conducting them and evaluating the results.

Another challenge as indicated by the participants was on managing large size classes which they said is difficult managing a class of more than forty learners single handedly during the practical test. Pereira (2010) indicated that sometimes the problem why experiments are not used for assessments is the lack of conditions necessary for experimentation, and the number of students per class might be excessive. The participants indicated that lack of resources and materials is another challenge they usually encounter in implementing experimentation-based assessments. Toh, Leong and Fork (2005) postulates that teachers recognize the importance of assessing practical skills but face several challenges like large class sizes which makes it difficult to

adequately observe and assess individual student performance during practical activities and limited time resources which constrain the variety and frequency of practical assessments.

Mrs Impala from school C said, “The laboratory is not well equipped, most of the equipment is outdated and are no longer functional. Fadzil and Saat (2013) aired the same view indicating that although many teachers believe they can transform science teaching through experimentation, experimental activities are infrequent in schools under the justification of lack of laboratories and those which have them do not have the resources to maintain them. Mr Dog from school D “Lack of resources limits the type of experiments that I will have planned as assessment most of the times I end up failing to implement experimentation- based assessments.” Jonhstone and AI-Shuaili (2001) acknowledged that there are several challenges associated with laboratory experimentation in science education such as limitations in resources, equipment and infrastructure, difficulties in managing large sizes and ensuring student engagement as well as focusing on concerns about the safety and organization of lab activities. The results show that the implementation of experimentation-based assessments is encompassed with a lot of difficulties in terms of infrastructure, availability of resources, time constrains and many others that need to addressed so implementation becomes an easy task on the part of the teacher.

4.2.7 Challenges faced by candidates during experimentation based examinations

On the challenges candidates face during examinations, Mr Duck from school B said, “Candidates make errors on the correct procedure and recording data. This leads to wrong results and wrong conclusions.” Osborne, Simon and Collins (2003) found that time constrains can lead to rushed work, mistakes and lack of attention to detail, which can negatively impact their performance. Mr Dog from school D also said, “Learners are used to conducting experiments in groups due to limited resources but in the examination they are required to work individually. Smith, Jones and

Callies (2012) highlighted that, many students lack hands-on experience with scientific equipment and instruments due to limited access to well-equipped laboratories in schools. This causes some of them to panic hence they make a lot of errors out of confusion." A study by Mudler et al (2018) highlights that pressure during examinations affects candidates' motivation, confidence and overall performance. It can lead to reduced problem-solving abilities and compromised decision-making skills. Lunneta, Hofstein and Clough (2007), practical examinations often require strong conceptual understanding of the underlying scientific principles and theories. Other challenges that were brought about by the Biology teachers were on time management during the examination they highlighted that candidates fail to finish the examination in one and half hours. A study by Eccles, Mc-Elhinney and Hendry (2016) found that time limitations in practical examinations can hinder candidates' ability to engage inessential process, compromise data collection and limit the breath of analysis and interpretation.

Another challenge that all participants concurred on was on lack of adequate materials during the examination. Candidates sometimes have to share equipment for example a scale. One made to wait for the other candidate to finish using the scale as a result some fail to finish exam in time. Mrs Cat from school E said, "The school does not supply materials during the term, materials are bought mostly for the exams. The challenge the candidates face is that they may not be familiar with materials and equipment hence they fail to use them properly, sometimes candidates produce results they are not sure of and they do not have a chance to repeat the procedure due to limited time and resources" Leach and Scott (2015) highlighted that unexpected outcomes in experiments can introduce cognitive challenges, requiring candidates to analyze the situation, identify potential errors or variations and adjust their methodology accordingly. These challenges concur with the findings of the research by Leach and Scott (2015), the above mentioned challenges that candidates

encounter during practical examinations in Biology can be a true reflection of what most Zimbabwean Biology candidates face hence a lot needs to bone to improve the implementation of experimentation in secondary schools.

4.2.8 Impact of experimentation-based assessments

All participants concurred that experimentation based assessments are an effective way of measuring learners understanding of concepts in Biology. Gormally, Brick, Hallar and Armstrong (2009) carried out a study that examined the impact of an inquiry- based learning approach on science literacy skills and they found out that implementing inquiry-based instructional methods in science classrooms can be an effective way to develop students overall scientific literacy and confidence. Mr Frog from A said, “Experimentation helps students to apply their scientific knowledge to real life situations.” Cook, Campbell and Hawkridge (2013) found that, experimentation in science education provide students with the opportunity to apply theoretical knowledge in practical setting enhancing their understanding and retention of concepts. Other participants also concurred on the view that experimentation enhances students’ curiosity and motivation. A research study by Ainely and Ainely (2011) indicated that student’s curiosity and motivation were positively influenced by practical-based tasks, suggesting a positive correlation between curiosity and academic performance. The responses of Biology teachers on the effectiveness of experimentation based assessments show that experimentation is not the only tool that can be used to measure learners’ level of concepts mastery, there is need to use experimentation along with other methods of assessment in order to come with a true reflection learners’ concept mastery.

4.2 9 Advantages of experimentation-based assessment

On the advantages of experimentation-based assessments, Mrs Impala from School C said. “I get the chance to assess the practical skills of my students through practical tests. Practical tests also boost learners’ interest and engagement in Biology since they get a chance to actually practice what I will have taught them.” Hirca (2013) highlights that, practical work can motivate students stimulate their interests in learning of scientific knowledge and widen their interests in learning of scientific knowledge and widen their way of thinking. All the other participants aired the same views on the advantages of experimentation-based assessments, highlighting that students develop critical thinking and problem solving skills; they develop skills of data collection, recording, presentation and drawing conclusions. Millar (2004) found that, practical work allows students to develop a range of practical skills such as use of scientific equipment, data collection, analysis and the interpretation of results. These views on the advantages of experimentation- based assessments concur with Kirschner (1992) who postulates that experiments allow students to develop important academic skills beyond just content knowledge and these skills include critical thinking, problem solving, data analysis and the ability to design and evaluate experimental procedures.

The researcher noted that using experimentation as a method of examining candidates in Biology at O level has many advantages from the responses of Biology teachers who work with Biology candidates on daily bases hence there is need to for schools to enhance the implementation of practical tests regularly. The researcher also found out that when experimentation is well-designed and implemented, it can have a positive impact on students’ conceptual understanding, practical skills and attitudes towards Biology.

4.2.10 Students performance and engagement

All participants indicated that they have noticed changes in students’ engagement and performance when using experimentation-based assessments. “When conducting experiment-based-

assessments, students actively participate since they will be constructing their own understanding of phenomena," said Mr Duck from school B. These views concur with ideas of Jonhstone and Shuaili (2001) who postulates that laboratory activities should be designed to support students in constructing their understanding rather than simply following a predetermined set of instructions. Freeman et al (2014) indicates that conducting experiments reinforces student's memory of scientific concepts and, leading to increased long term retention. The results above are an indication of the impacts of experimentation-base assessments like increasing students' interest and engagement.

4.2.11 School support systems

Mrs Chiromo from school C said, "The school administration is supportive because they have introduced a practical fees levy which is used for procuring materials for experiments and some renovations are being made in the laboratory." Mrs Cat said. "The school is not very supportive I made attempts to request for renovations in the laboratory and to get new materials but to avail." Argarwal and Ohri (2018) found that schools in resource constrained settings often struggle to provide the necessary materials and equipment for hands-on experiments. Other participants indicated that materials are not always available and their schools always complain on the cost of materials and equipment. Downie, Daly and Braund, (2019) found that schools in low-income areas struggle with limited access to laboratory resources, hindering their ability to implement practical assessments effectively. The results indicate that lack of support in terms of infrastructure and resources hinders the implementation of experimentation-based assessments during the course of the teaching and learning period.

4.3: DATA COLLECTED FROM QUESTIONNAIRES

Questionnaires were distributed to 5 HODs from 5 schools.

4.3.1 Familiarity with experimentation

All the HODs indicated that they were familiar with the concept of experimentation in Biology. The researcher noted that the sciences departments of all the five schools were being led by personnel well versed with concepts in the teaching and learning of Science subjects like Biology. These responses indicate that leaders in the Science departments of schools that offer Biology are aware that Biology is a subject that requires a hands-on approach.

4.3.2 Perception on experimentation as a method of examining candidates in O level Biology

HODs B, C and E indicated that experimentation is an effective method of examining candidates in O level Biology. HODs A and D indicated that experimentation is a moderately effective method of examining candidates in O level Biology. All the participants also agreed that experimentation as a method of examining candidates provides a more comprehensive assessment of the learners understanding of Biological concepts. Jonhstone and Shuauli (2001) argue that experimentation helps in the understanding of scientific concepts, processes and skills. Prince (2004) highlights that unlike traditional exams or written assignments, experiments assess students 'practical abilities and their understanding of scientific procedures and, data analysis and interpretation. Results on the perceptions of HODs indicates that experimentation as a method of examining candidates is of great value as it is viewed as an effective way of examining candidates in O level Biology.

4.3.3 Advantages of experimentation as a method of examining candidates

All HODs concurred that utilizing experimentation in examinations allows students to demonstrate their problem solving skills. Prince (2004) supports these results as he is of the idea that

experiments reduce reliance on rote memorization. They also concurred that experimentation has other advantages such as enhancing students' practical knowledge and application of biological principles, promoting critical thinking and analytic skills. Recommendations of the study by Jonhstone and Shuauli (2001) supports that incorporating inquiry-based approaches in laboratory activities promote deeper understanding of and active engagement as this encourages students to formulate hypotheses, design experiments, collect and analyze data and drawing conclusions rather than just following asset of instructions. Freeman, McDounough, Smith, Okoroafor, Jordt and Wenderoth (2014) found out that experiments assess the students' practical abilities and their understanding of scientific procedures, data analysis and interpretation. The results highlights that experimentation as a method of examining candidates has many advantages such as enhancing candidates' practical knowledge, promoting the development of analytic and problem solving skills and application of biological principles.

4.3.4 Incorporation of experimentation in O level Biology teaching and examinations

All HODs indicated that Biology teachers in their departments incorporate experimentation as an assessment method during the course of the teaching process. Rudolph, Minisky and Lindgreen (2001) concur with the idea of incorporating experimentation as assessment as they brought out the idea that experiments allow students to observe and experience scientific phenomena first hand leading to a greater conceptual understanding of the subject matter. The HODs also agreed that they recommend the incorporation of experimentation as a method of examining candidates in O level Biology. Abrahams and Reiss (2012) postulates that, the learning outcomes of experimentation are not automatic, they depend heavily on how the practical activities are structured and supported. These results concur with the findings of the research by Donlosky,

Rawson, Marsh, Nathan and Willingham (2013) who indicates that experiments engage students in active learning thereby allowing them to participate directly in the scientific process. The results from the questionnaires by HODs indicates that stake holders in the teaching and learning of Biology supports the idea of incorporating experimentation as a method of assessing learners during the course of teaching and learning period.

4.3.5 Challenges by faced by teachers when incorporating experimentation as an assessment method

All participants concurred that Biology teachers face challenges such as, time constrains in preparing for experiments, lack of equipment and resources as well as difficulties in developing suitable assessment criteria for experimental tasks when incorporating experimentation as an assessment method. Linn (2005) highlighted that curriculum and syllabus requirements can be demanding, leaving limited time for conducting experiments. None of the participants indicated that teachers face challenges like students' resistance towards practical based examinations. Toh, Leong and Fork (2005) carried out a study in Singapore and found that teachers recognise the importance of assessing practical skills but face several challenges like large class sizes, limited time and resource as well as difficulties in designing and implementing appropriate assessments. Wobmann (2000) found out that when experimentation is not adequately emphasized in assessments, students may struggle to grasp the underlying principles and theories, leading to a superficial understanding of scientific concepts. The results on challenges faced by teachers when incorporating experimentation are an indication of constrains that are faced by Biology teachers in Gutu schools when trying to incorporate experimentation as method of examining candidates in Biology at O level.

4.3.7 SUMMARY

The chapter was mainly focusing on the presentation and analysis of data collected from in- depth interviews and questionnaires. Data was presented as themes and sub-themes, tables and pie charts were also used to present data.

CHAPTER 5:

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION

The chapter gives a summary of the whole research study, make conclusions of the findings and suggest some recommendations.

SUMMARY

The research sought to investigate the effects of experimentation as a method of examining candidates in Biology at O level in Gutu District. The research investigated the benefits of using experimentation as a method of examining candidates at O level in Biology, the challenges faced by Biology teachers when incorporating experimentation as a method of assessment, challenges that candidates face during experimentation-based assessments and the impacts of experimentation as a method of examining candidates in Biology at O level.

The assessment methods in used in O level Biology include practical examinations to evaluate candidates' ability to conduct experiments, record observations, analyze data and draw conclusions. Traditionally assessments in Biology have heavily relied on written exams requiring students to memorize and regurgitate information. There are significant gaps in the implementation of experimentation as a method of assessing learning, biology curricula and assessments in secondary schools often prioritize theoretical knowledge over practical application.

The researcher's theoretical framework was based on Brunner's Discovery Learning Theory and Kolb's Experiential Learning Theory. Discovery learning is a theory that suggests learners can effectively acquire knowledge and understanding through exploration, inquiry and problem solving. Bruner proposes that, the purpose of education is not to impart knowledge, but instead to facilitate a child's thinking and problem-solving skills which can be transferred to a range of situations. Brunner also proposes that, learners construct their knowledge though their experiences and interactions with the environment. Experimentation as a method of examining candidates in Biology at O level provides an opportunity for active learning where candidates engage in hands-on experiences and actively explore biological concepts through experiments.

The Experiential Learning Theory by Kolb proposes that learning occurs through a continuous process that involves experiencing, reflecting, thinking and then taking action. The ELT proposes that individuals acquire knowledge through direct experience, reflect on that experience, forming abstract concepts and then testing those concepts in new situations. The use of experimentation aligns well with the principles of the Experiential Learning Theory in the sense that experimentation allows students to engage in concrete experiences where they actively manipulate variables and observe the outcomes, the concrete experience then leads to a phase of reflective observation where the students analyze their findings and make sense of the underlying concepts.

The study was set in Gutu District Masvingo province. The researcher purposively sampled five schools in Gutu Central Constituency; the sampled schools are situated along the Gutu Bhasera road approximately 40km from Mupandawana Growth Point where the district education offices are found. The schools are high schools that offer Biology as a subject at O and A levels. The researcher employed the qualitative research paradigm which could bring out narratives and descriptions on the effects of experimentation as a method of examining candidates in Biology at O level. The qualitative research design provides a deeper understanding of phenomena under study and allows the researcher to investigate deeper on issues getting opinions, views and perceptions of the research participants. The researcher employed a qualitative case study since it provides the chance to focus on a small area which is rich in concepts being investigated. The researcher used in-depth interviews and questionnaires to gather data at the selected 5 schools. The researcher approached the Provincial Education Directors office to get permission to conduct the study. A pilot study was conducted and the research instruments were edited before the actual study. The participant's responses on interviews were audio recorded, transcribed and used as primary data. Responses from questionnaires were also used. The data was presented, analyzed

and discussed in thematic form where the researcher coded themes and discussed subthemes under them. Tables and pie charts were also used to present data.

The researcher found that both summative and formative assessments are used in the form of structured questions, multiple choice, presentations and practical test for assessing O level Biology learners. Methods used to assess O level students are generally the same in schools. Teachers are willing to incorporate experimentation as a method of assessing learners regularly during the course of the teaching period but they are not getting enough support from the school authorities. Experimentation-based assessments are faced with many challenges as a result candidates end up sitting for practical examinations without practicing much during the course of the teaching and learning period. Experimentation as method of examining O level Biology candidates has advantages such as enhancing candidates motivation, engagement and the development of skills such as data recording, presentation, analysis and drawing conclusions. the implementation of experimentation-based assessments is encompassed with many challenges in terms of infrastructure, availability of resources, time constrains, large class sizes, lack of support from school authorities and lack of teacher training in designing and conducting experiments. Candidates encounter challenges during experimentation-based examinations such as making errors on the correct procedure, panicking due to examination pressure, failing to finish the exam due to time constrains and in adequate materials since they might have to share materials during the exam and they may fail to use equipment properly because they may not be familiar with it.

CONCLUSIONS

The researcher concluded that, using experiments as a method of examining O level Biology candidates have several impacts such as enhancing students' understanding of Biology concepts,

contribute to the acquisition and development of social scientific skills which are data analysis, research design and problem solving, fosters motivation and engagement.

Experimentation is not being effectively incorporated in schools that offer Biology but rather the main concern is on final ZIMSEC examinations. Experimentation is not being incorporated as a tool for formative and summative assessment during the course of the teaching and learning periods. The effects of using experimentation as a method of examining candidates in Biology at O level are being overlooked.

Incorporation of experimentation-based is encompassed with a lot of challenges that need to be addressed in order to make it easy for the teachers and candidates. Learners are not used to conducting experiments as they learn hence it becomes challenging to carryout experiments during examinations without panicking.

RECOMMENTATIONS

The researcher makes the following recommendations:

The need to incorporating experimentation regularly in the teaching and learning of biology so that students understand what they are expected to learn and achieve through the experimentation process. School administrators should try by all means to make sure that the school has standard facilities, equipment and materials in order to enhance the incorporation of experimentation as a method of assessment in Biology.

Students must be provided with ample opportunities for hands-on experience with experiments. There is need to ensure that students have access to the necessary materials, equipment and resources to conduct experiments effectively. Teachers to implement a scaffold approach to experimentation which begins with simple experiments and gradually increasing the complexity as students gain proficiency. Teachers should provide step-by-step instructions, guidance and demonstrations to help students understand the experimental process and build their confidence.

Biology teachers should use formative assessment techniques to provide feedback to students during experimentation-based assessments. Students need to be given constructive feedback on their experimental design, data collection and analysis. The teacher should identify areas of improvement and provide guidance for further learning.

The Ministry should provide Biology teachers with professional development opportunities and training in effective experimental teaching strategies. There is need also to support teachers in designing and implementation of experiments that align with the curriculum and academic standards. Well prepared teachers can guide students through the experimental process more effectively.

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APPENDIX

APPENDICES 1

INTERVIEW GUIDE FOR BIOLOGY TEACHERS

I would like to thank you for agreeing to participate in this study. My name is Gaudencia Chisvinga, a Bachelor of Science Education Degree in Biology student at Bindura University of Science Education. I am here to collect data for my research study on the effects of experimentation as a method of assessing learners in O Level Biology. I comply to research ethics like privacy and confidentiality. I wish to assure you that no part of this discussion will be used for any other use apart from the completion of this degree.

1. Participants' gender.

2. What professional qualification do you have?

3. How long have you been teaching O level Biology?

4. What methods of assessment do you use?

5. Have you ever utilized experimentation as an assessment method in Biology?

6. How do you incorporate experimentation into your assessments?

7. How do you assess the practical skills of learners through experimentation?

8. What do you think are the benefits of using experimentation in assessing learners in Biology?

9. What challenges do you face when implementing experimentation-based assessments?

10. What challenges do learners face during practical examinations?

11. What is your opinion on the extent to which experimentation can effectively measure learners understanding of Biological concepts?

12. What do you think are the impacts of using experimentation as a method of examining O level candidates?

13. What do you think are the advantages of experimentation-based assessments compared to other methods?

14. Have you observed changes students' engagement and performance when using experimentation-based assessment?

15. Is the school supportive in enhancing the implementation of experimentation-based assessment?

This is the end of our interview. I would like to thank you for your time and commitment.

APPENDICES 2

QUESIONNAIRE FOR HEADS OF DEPERTMENTS

INTRODUCTION

I would like to thank you for agreeing to participate in this study. My name is Gaudencia Chisvinga, a Bachelor of Science Education Degree in Biology student at Bindura University of Science Education. I am her to collect data for my research study on the effects of experimentation as a method of examining learners in O Level Biology. I comply to research ethics like privacy and confidentiality. I would like to assure you that no part of the information you are going to provide will be used for any other use apart from the completion of this degree.

Encircle the selected responses

1. What is your gender?

a) Male

b) Female

2. Professional qualifications

a) Diploma

b) Degree

3. What is your position?

a) Head of Science Department.

a) Assistant of Head of Science Department.

4. How long have you been leading the Sciences Department?

a) Less than a year

b) 1- 3 years

c) 4-6 years

d) More than six years

5. How familiar are you with the concept experimentation in Biology?

a) Very familiar

b) Moderately familiar

c) Slightly familiar

d) Not familiar at all

6. How do you perceive experimentation as a method of examining candidates at O level Biology?

a) Very effective

b) Moderately effective

c) Slightly effective

d) Not effective at all

7. Experimentation as a method of examining candidates provides a more comprehensive assessment of the learners understanding of Biology concepts.

a) Agree

b) Disagree

c) Strongly Disagree

8. Utilizing experimentation allows students to demonstrate their problem solving skills.

a) Agree

b) Disagree

c) Strongly Disagree

9. Experimentation based assessments enhance students' practical knowledge and application of Biological principles.

a) Agree

b) Disagree

c) Strongly Disagree

10. Experimentation in examinations promotes critical thinking and analytic skills among students.

a) Agree

b) Disagree

c) Strongly Disagree

11. Experimentation activities should contribute to the final marks in O level Biology.

a) Agree

b) Disagree

c) Strongly Disagree

12. Do Biology teachers in your department incorporate experimentation as method of assessment during the course of the teaching process?

a) Yes

b) No

13. What challenges do teachers encounter in experimentation as a method examining candidates? (Select all that apply)

a) Time constrains in preparing for experiments.

b) Lack of resources or equipment.

c) Difficulty in developing suitable assessment criteria for experimental tasks.

d) Resistance from students towards practical based examinations.

14. What are the potential impacts of implementing experimentation as a method of examining candidates in Biology at O level?

a) Improved understanding of Biology concepts among students.

b) Better preparation for higher education in the field of Biology.

c) Increased engagement and interest among students

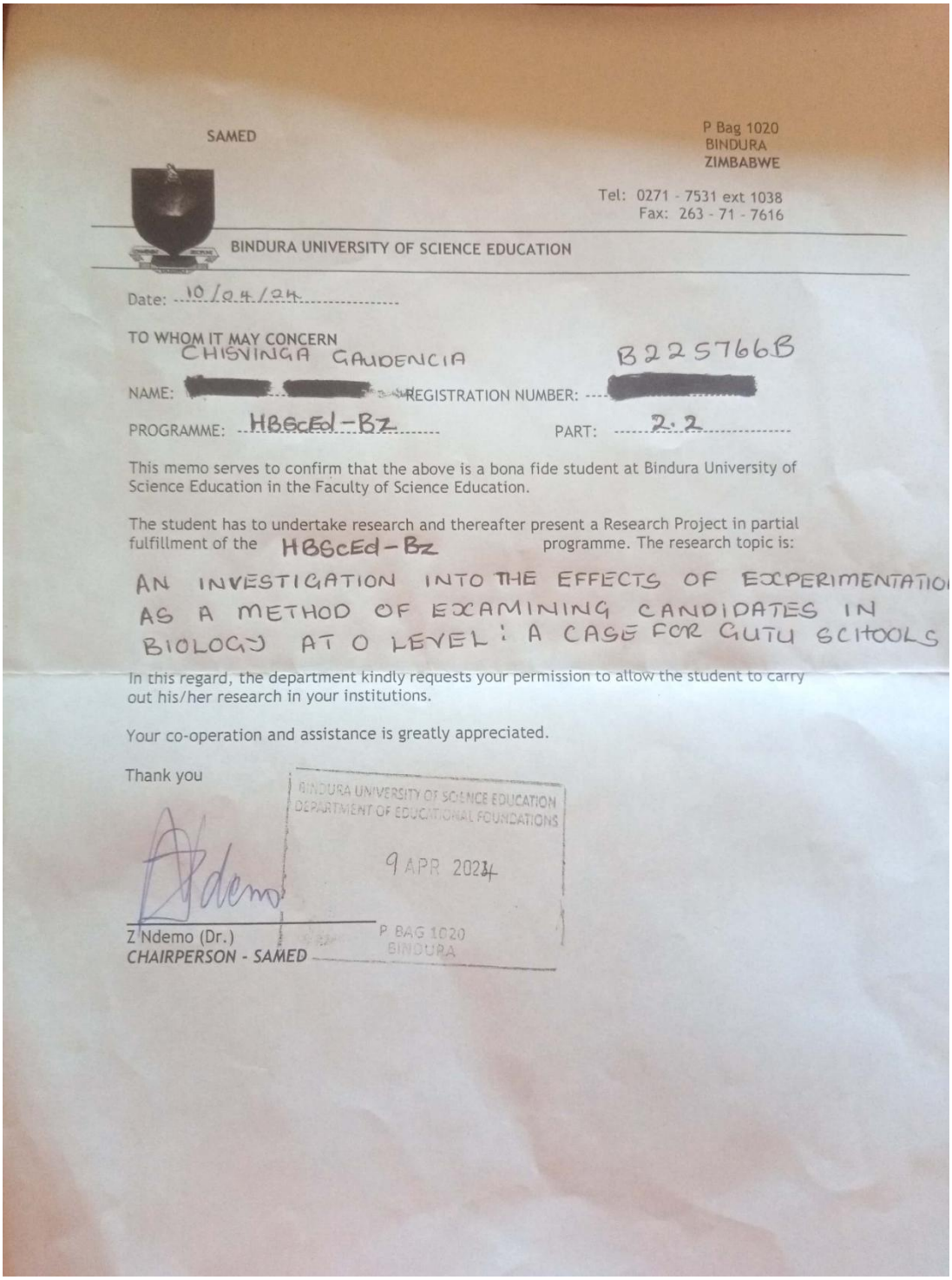
d) Potential improvement in examination scores.

15. Would you recommend incorporating experimentation as a method of examining candidates at O Level Biology?

a) Yes

b) No

APPENDICES 3: APPLICATION FOR RESEARCH PERMISSION



SAMED

P Bag 1020
BINDURA
ZIMBABWE

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

BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date: 10/04/24

TO WHOM IT MAY CONCERN

NAME: CHISVINGA GAUDENCIA [redacted] REGISTRATION NUMBER: B225766B [redacted]

PROGRAMME: HBScEd-Bz PART: 2.2

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

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

AN INVESTIGATION INTO THE EFFECTS OF EXPERIMENTATIO
AS A METHOD OF EXAMINING CANDIDATES IN
BIOLOGY AT O LEVEL: A CASE FOR GUTU SCHOOLS

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

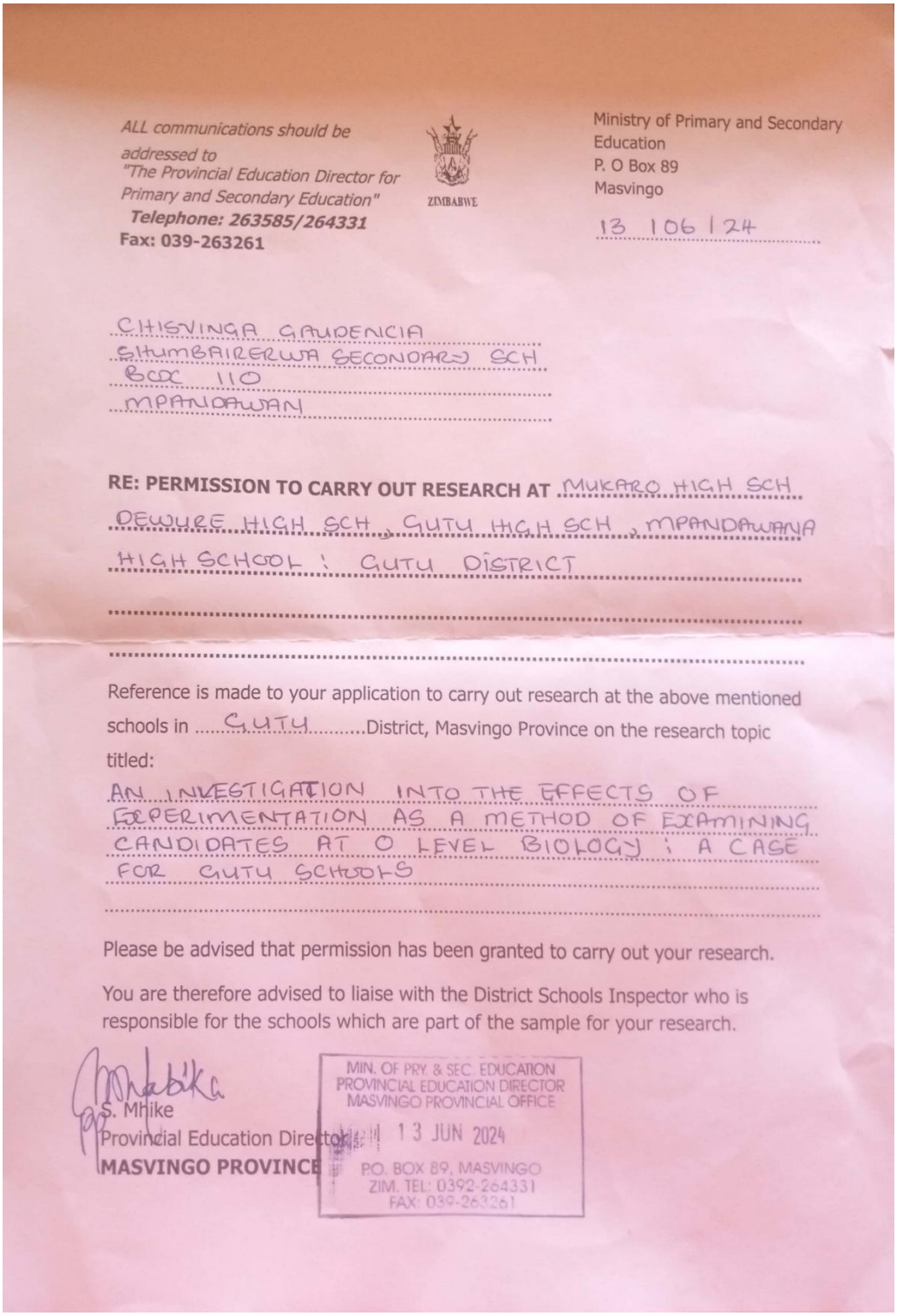
Your co-operation and assistance is greatly appreciated.

Thank you

BINDURA UNIVERSITY OF SCIENCE EDUCATION
DEPARTMENT OF EDUCATIONAL FOUNDATIONS
9 APR 2024
P BAG 1020
BINDURA

Z Ndemo (Dr.)
CHAIRPERSON - SAMED

APPENDICES 4: APPROVAL LETTER



ALL communications should be addressed to "The Provincial Education Director for Primary and Secondary Education"
Telephone: 263585/264331
Fax: 039-263261

ZIMBABWE

Ministry of Primary and Secondary Education
P. O Box 89
Masvingo

13 106 124

CHISVINGA GAUDENCIA
SHUMBAIRERWA SECONDARY SCH
BOX 110
MPANDAWANA

RE: PERMISSION TO CARRY OUT RESEARCH AT MUKARO HIGH SCH, DEWURE HIGH SCH, GUTU HIGH SCH, MPANDAWANA HIGH SCHOOL : GUTU DISTRICT

Reference is made to your application to carry out research at the above mentioned schools in GUTU District, Masvingo Province on the research topic titled:

AN INVESTIGATION INTO THE EFFECTS OF EXPERIMENTATION AS A METHOD OF EXAMINING CANDIDATES AT O LEVEL BIOLOGY : A CASE FOR GUTU SCHOOLS

Please be advised that permission has been granted to carry out your research.

You are therefore advised to liaise with the District Schools Inspector who is responsible for the schools which are part of the sample for your research.

S. Mhike
Provincial Education Director
MASVINGO PROVINCE

MIN. OF PRY. & SEC. EDUCATION
PROVINCIAL EDUCATION DIRECTOR
MASVINGO PROVINCIAL OFFICE
13 JUN 2024
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