INVESTIGATING THE EFFECTS OF USING IMPROVISED INSTRUCTIONAL MATERIALS ON GRADE 11 LEARNERS' ACHIEVEMENT IN BIOLOGY AT A SELECTED REMOTE SCHOOL IN OMUTHIYA CIRCUIT

THESIS SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF EDUCATION (SCIENCE EDUCATION)

OF

THE UNIVERSITY OF NAMIBIA

BY

JOHANNES SHIPEPE

201403758

APRIL 2025

MAIN SUPERVISOR: PROF SACKY M. IIPINGE (UNIVERSITY OF NAMIBIA)

CO-SUPERVISOR: DR LEENA L. T. NGHIPANDULWA (UNIVERSITY OF NAMIBIA)

ABSTRACT

The aim of this study was to investigate the effects of using improvised instructional materials on Grade 11 learners' achievement in Biology at a selected school in Omuthiya circuit, Oshikoto region. The study also sought to uncover how improvised instructional materials contribute to learners' achievement in Biology and the views of the learners in the experimental group on the effect of using improvised instructional materials in the teaching and learning of Biology. The study employed a mixed-method approach which used a qualitative case study and a quasi-experimental design. The population of this study was all nine (9) secondary schools in Omuthiya circuit with a population of about 758 learners. Purposive sampling method was used to select one secondary school that offers Biology from nine secondary schools in the circuit. The selected school had one Grade 11 class with thirty (30) learners doing Biology, which were then further randomly divided into two groups (Experimental group and Control group). This was done by picking pieces of papers mixed up in jar written their names. The first fifteen names picked were placed in group A, while the remaining fifteen were placed in group B. A Biology Achievement Test (BAT) of a pre-test and post-test was used to gather quantitative data, while focus group discussions were used to collect qualitative data. Furthermore, data were analysed using Microsoft Excel and thematic data analysis. Triangulation was also used to allow validation of data through a cross-verification of findings from qualitative and quantitative approaches.

The key findings of the study show that using improvised instructional materials in the teaching and learning of Biology has a positive effect on Grade 11 learners' achievement in that subject. In addition, it was established that improvised instructional materials help learners to understand the content easily because it brings fun to the lessons and learners are familiar with the materials being used. The findings

further revealed that improvised instructional materials provide learners with an opportunity to visualise the subject content being taught, which then makes it easy for learners to remember the content. However, the study revealed that some of the improvised instructional materials can be dangerous depending on the materials they are made from. The study recommends that the Ministry of Education Arts and Culture invest more in procuring the usual traditional instructional materials as well as acquiring and supplying more raw materials that teachers can use at schools to make improvised instructional materials. In addition, the Biology Senior Education Officers should facilitate workshops to train teachers on the needed skills in setting up improvised instructional materials and precautions that teachers need to be aware of when dealing with such materials.

Key words: Improvised instructional materials; Experimental group; Control group; Achievement; Biology; Learners

DEDICATION

This piece of work is dedicated to:

My parents: Meme Eve Kosmas and Tate Johannes Shipepe

My grandmother: Kuku Wilhelmina Negongo

My siblings: Auguste, Mateus, Toivo, Tresia and Vilho

You have been an inspiration in this academic journey, and you motivated me to work hard when things were tough. I thank you all for being kind and helpful.

This thesis is for you, salute!

ACKNOWLEDGEMENT

Firstly, I wish to thank the Almighty God for he has been with me throughout this entire academic journey. I would not have completed this thesis if it was not for His grace and protection.

Secondly, I would like to express my sincere appreciation to my supervisor, Prof S.M. Iipinge, and co-supervisor, Dr LLT Nghipandulwa, for their incredible professional advice, unconditional support, unwavering understanding and positive criticisms that made this study a success.

I would also like to acknowledge and appreciate the support I received from my friends and family who stood firm beside me during my schooling years. Thank you very much for your support and encouragement.

Finally, my sincere appreciation goes to the Oshikoto Directorates of Education for allowing me to conduct my study at a school located in the Oshikoto region. My deep appreciation also goes to the principal, teachers and learners for granting me permission to conduct my study at their school, despite their busy schedules; they still deemed it fit to help me at their level best.

LIST OF ABBREVIATIONS AND ACRONYMS

BAT – Biology Achievement Test

DEC – Decentralised Ethics Committee

GPA – Grades Point Average

MoEAC – Ministry of Education, Arts and Culture

NCBE – National Curriculum for Basic Education

NEACB – National Examination, Assessment and Certification Board

NIED – Namibian Institute for Educational Development

NRC – National Research Council

NSSCO – Namibian Senior Secondary Certificate

USA – United States of America

LIST OF TABLES

LIST OF FIGURES

TABLE OF CONTENTS

APPROVAL PAGE

This research has been examined and approved as meeting the required standards for partial fulfilment of the requirements of the degree of Master of Education.

……. …….....

Internal Examiner Date

…… …….....

External Examiner Date

……... ……

Dean: Faculty of Education Date

DECLARATION

I, Johannes Shipepe, hereby declare that this study on *"Investigating the effects of improvised instructional materials on Grade 11 learners' achievement in Biology at school X in Omuthiya circuit"* is a true reflection of my own research and that this work or part thereof has not been submitted for a degree in any other institution of higher education.

Johannes Shipepe		April 2025
Name of student	**Signature**	**Date**

CHAPTER 1: INTRODUCTION

1.1 Introduction

This section introduces the study concerning the effects of using improvised instructional materials on Grade 11 learners' achievement in Biology on the topic of "Gas exchange in humans" in a selected school in Omuthiya circuit, Oshikoto region. It presents the background of the study, statement of the problem, research question, hypothesis, significance of the study, limitation of the study, delimitation, and definitions of terms.

1.2 Background of the study

Biology is one of the basic sciences whose teaching and learning are globally acknowledged as influential in learners' everyday lives (Ibrahim et al., 2019). Mayr (2004) indicated that Biology functions as a significant viaduct that connects physical sciences and humanities; therefore, the philosophical foundation of Biology is specifically important in explaining mind and consciousness. Historically, major improvements in biological sciences have presented answers to social and economic challenges (National Research Council [NRC], 2009). At the same time, these challenges guide science to focus on critical societal needs that will eventually lead to the foundation of countless new products and industries (NRC, 2009).

Through curriculum reform, the Ministry of Education, Arts and Culture (MoEAC, 2016) advocated for a curriculum that directs basic education to the realisation of Namibian Vision 2030 that is promoting for "a prosperous and industrialised Namibia, developed by her human resources, enjoying peace, harmony and political stability" (p. 2). Moreover:

> Namibia Vision 2030 sees Namibia developing from a literate society to a knowledge-based society where knowledge is constantly being acquired and renewed and used for innovation to improve quality of life. A knowledge-based society requires people who are healthy, well-educated, skilled, and pro-active, and who have a broad range of knowledge-based abilities. This needs a high level of human resource development, and basic education provides the foundation for human resource development for the society of the future. (MoEAC, 2016, p. 2)

The MoEAC (2016) further alluded that Natural Sciences (Biology included) in the Namibia Senior Secondary Certificate Ordinary (NSSCO) should be an area where learning adds to the foundation of a knowledge-based society by equipping learners with skills and knowledge to generate hypotheses, observe and investigate scientifically. The NSSCO is a two-year course (grades 10-11) whereby learners write an examination at the end of the course level to meet the requirements for the National Curriculum for Basic Education (NCBE) that is approved by the National Examination, Assessment and Certification Board (NEACB) (MoEAC, 2018). In NSSCO Biology, the MoEAC (2018) points out three main assessment objectives, namely: "(a) knowledge with understanding – focused on what learners need to recall and understand, (b) handling of information, application and solving problems, and (c) practical skills and ability – that involve applying skills in real-world tasks" (p. 3).

However, it is strongly advised that the assessment objectives must be achieved through a proper curriculum implementation that includes the use of the learner-centred approach in the teaching and learning process (MoEAC, 2018). Bremner (2021) defined learner-centred education as a type of learning where learners are actively involved in the teaching and learning process rather than being seen as empty

vessels that wait to be filled with knowledge from teachers; therefore, teachers are seen as facilitators. Furthermore, suitable teaching methods and instructional materials shall be used to ensure the objectives are met based on the learners' needs (MoEAC, 2018). According to Igiri and Effiong (2015), instructional materials are items that a teacher can use to create a clear picture in conveying information to learners during the teaching and learning process. In addition, Ibrahim et al. (2019) explained that instructional materials are significant in ensuring that there is effective interaction between teachers and learners in the process of teaching and learning.

In Namibia, secondary schools are battling a lack of funds to buy the instructional materials that teachers and learners need to carry out the learning process (Hamunyela et al., 2022; Nghishongwa, 2017). Verner et al. (2022) who investigated the challenges affecting Grade 12 learners' performance in NSSCO Biology in the //Kharas region, Namibia found that "out of twelve (12) teachers that took part in their study only three (3) agreed that there are laboratory equipment in their Biology laboratories" (p.70). inadequacy of teaching and learning resources in Namibian schools more specifically those in remote areas remains as one of the factors leading to a low learners' performance rate (Muyoyeta et al., 2018; Ndjangala etal., 2021). However, Enenya and Muhammad (2018) indicated that in the absence of standard instructional materials, teachers and learners tend to use improvised instructional materials to meet the subject objectives. Improvisation is defined as the act of using available materials from the local environment in the process of teaching and learning (Okeke, 2019).

For this study, the secondary school where the study was conducted is a school in remote area situated 14 km away from Omuthiya town. With an enrolment of 427 learners in total and it is operating from pre-primary to grade 11. Furthermore, due to no hostel provision at the school, all learners commute daily from their houses. The

researcher observed that the school lacked various infrastructures such as, an administration block, a library, laboratory rooms and standard instructional materials, just to mention a few. Based on those circumstances, teachers tend to rely more on the use of traditional instructional materials such as textbook and chalkboard in the process of teaching and learning. Also, the circumstances led to teachers delivering most of their lessons in theory method even in topics where more practical work could help to achieve the targeted learning objectives. However, despite all odds the school managed to come 3rd in the circuit for the 2023 academic year results for National Senior Certificate Ordinary level (NSSCO).

As a Biology teacher for several years now, I have noted with serious concern about the lack of teaching resources especially in schools situated in remote areas and how this affects the provision of quality education for our learners. Through my teaching of Biology and my participation in curriculum development activities at the Circuit level, I have not only come to experience the shortage of teaching resources, and the frustration associated with that for both teachers and learners, but I have also developed a special interest in trying to understand how Biology teachers can use improvised instructional materials to influence learners' achievement. This study is, therefore, important because it has real-life relevance to me as a Biology teacher in one of the remote secondary schools in Namibia. Hence, this study sought to investigate the effects of improvised instructional materials on Grade 11 learners' achievement in Biology at a selected school in Omuthiya circuit, Oshikoto region.

1.3 Statement of the problem

Different researchers have noted that the improvisation of teaching materials brings about a reduction in costs in education, it encourages learners to develop creativity and helps teachers to maintain and grasp learners' interest towards Biology (Ibrahim et al.,

2019; Ibrahim et al., 2021). A study on improvised experimental materials for Science in Rwanda by Ndihokumboyo (2016) found that improvisation in science gives a better way of knowledge attainment through doing, where learners are provided with an opportunity to learn hands-on with low wasted materials in their environments. However, it was also observed that teachers lack skills in how to create and use improvised instructional materials (Ndihokumboyo, 2016). Furthermore, Verner et al. (2022), in a study conducted in the //Karas region of Namibia on the challenges affecting grade 12 learners' performance in Biology, found that a lack of instructional materials contributes to the high-rate failure in NSCASS Biology. The same study recommended that teachers and learners need to adopt the act of improvisation in instructional materials to improve the passing rate. However, there is no study done in Namibia on the effects of improvised instructional materials on the achievement of learners in Biology. Therefore, this study sought to explore the effects of improvised instructional materials on Grade 11 learners' achievement in Biology at School X in Omuthiya Circuit.

1.4 Research question

This study was guided by the following research question:

1. What are the effects of using improvised instructional materials on the Grade 11 learners' achievement in Biology at School X in Omuthiya Circuit?

1.5 Sub-research questions

1. How do improvised instructional materials contribute to learners' achievement in Biology?

2. What are the views and experiences of learners in the experimental group on the effects of using improvised instructional materials in the teaching and learning of Biology?

1.6 Hypotheses

Based on the research question, the following hypotheses were tested:

$\mathbf{H_0}$ There is no statistically significant difference in the performance of the Grade 11 learners' achievement in Biology between those taught with improvised instructional materials and those taught using the usual traditional method.

$\mathbf{H_1}$ There is a statistically significant difference in the performance of the Grade 11 learners' achievement in Biology between those taught with improvised instructional materials and those taught using the usual traditional method.

The level of significance in testing the above hypothesis was as follows: If the p-value is less than or equal to the alpha ($p \leq 0.05$) then the null hypothesis (H_0) will be rejected. However, if the p-value is greater than alpha ($p \geq 0.05$) then the null hypothesis will be accepted.

1.7 Significance of the study

The Ministry of Education, Arts and Culture through its agencies such as the National Institute for Educational Development (NIED) may benefit from this study by realising the importance of using improvised instructional materials in the teaching and learning of Biology in Grade 11. The study's recommendations may also provide vital information that can help Biology teachers with the planning, design and use of improvised instructional materials when teaching Biology in Grade 11. Furthermore, it is hoped that teachers will get to know the effectiveness of using improvised instructional materials towards the learning objectives of Biology. Learners' interest in Biology might also be boosted which might then lead to improved performances in the

subject. Lastly, this study will contribute to Namibian literature on the effects of improvised instructional materials on learners' achievement in Biology.

1.8 Assumptions of the study

In this study, the following assumptions were made:

1. Learners taught with improvised instructional materials would achieve better scores than those taught with usual traditional instructional materials. This is because improvised instructional materials stimulate more knowledge and understanding in learners than usual traditional instructional materials.
2. Improvised instructional materials can arouse learners' interest in Biology, which would then increase learners' achievement in the subject.
3. Given that this was a mixed-method study, one might assume that the findings would be valid and reliable as the results are triangulated.
4. During the discussions, the researcher assumed that the learners would provide answers honestly as they were guaranteed of confidentiality and their responses were safe.
5. Information collected through the discussion would correlate with the results from the Biology Achievement test.

1.9 Limitations of the study

As far as the design is concerned, the research focused only on the effects of improvised instructional materials in Biology in Grade 11 at School X in Omuthiya Circuit, Oshikoto region. Therefore, the design of the study may limit the study in the context that its findings cannot be generalised to other schools in the circuit or countrywide. Moreover, since the data were collected after normal school hours, the study's sample responses in the tests and the focus group discussions might have been

influenced by other environment-related conditions such as high temperature in the classroom which could make learners lose focus and respond to questions with the aim of finishing early to escape the heat. However, the researcher ensured that the control group and experimental groups were properly administered to minimise the influence of factors other than those that were under study, which might influence the validity of the study. Furthermore, due to tiredness, some learners left some questions unanswered. The effect of this on validity could be that the test scores or the discussion responses of those specific learners would not indicate their true reflection. To mitigate this, the researcher encouraged the participants to answer all the questions with honesty by explaining the importance of the study and its possible benefits to the subject of Biology. Also, a pre-knowledge assessment for all participants prior to groups placement was not conducted. However, the researcher made sure that all participants were placed in those two groups randomly to provide each participant with equal chance of being placed in any. Lastly, the study sample size was relatively small. The effect of this on validity could be that the test mean scores would not be able to show a statistically significant difference. To mitigate this, the researcher carried out focus group discussions to get learners' in-depth views about the use of improvised instructional materials.

1.10 Delimitations

To reduce time spent on the study, out of nine schools offering Biology in Grade 11 in Omuthiya Circuit, only one school was included in the study. The selected secondary school is one of the combined schools whose phase got extended to secondary schools due to the implementation of the revised curriculum for basic education in Namibia. The school is situated in the Omuthiya rural area, about 30 km away from Omuthiya town. Due to a lack of facilities, the school could only accommodate thirty learners in

Grade 11, of which all were doing Biology. Furthermore, there is only one teacher who is responsible for teaching Biology. Theory is the most used method of delivering Biology lessons at the school. The teacher responsible stated that they do not have enough materials to help them use other teaching methods since the school was recently handed a senior secondary phase (grade 10-11s). Although the school was purposively selected from the total nine secondary schools in the circuit, the distance from where the researcher resides and the selected school in comparison with other secondary schools in the circuit was one of the factors that made the school a suitable target source of data. Also, having known the school's challenges when it comes to standardized instructional materials and teaching facilities, the researcher therefore found the selected school ideal to see the effect of improvised instructional materials on Grade 11 learners' achievement in Biology.

Moreover, the study covered only one topic from Biology which is Gas exchange in humans. This topic was specifically selected from the syllabus because of its content and objectives that are more practical. Hence, it gives a better assessment quality especially in discovering the effects of improvised instructional materials on learners' achievement.

1.11 Definitions of Terms

In this research, the succeeding terms are defined as follows:

Instructional materials: This term refers to apparatuses aimed at making teaching and learning meaningful and effective in a way that learners understand (Sale, 2016).

Improvised instructional materials: This term refers to apparatuses that are created from materials from the environment and they are intended to ease instructions in the absence or shortage of standard instructional materials (Iji et al., 2014).

Standard instructional materials: This term refers to instructional materials that are sophisticated and are often imported (Omosewo, 2011).

1.12 Brief overview of chapters

Chapter 1 provides the background of the study, which investigated the effect of improvised instructional materials on Grade 11 Learners' achievement in Biology at a selected secondary school in the topic of "Gas exchange in Humans". The statement of the problem, research question, hypothesis, significance of the study, assumption of the study, delimitations, and definition of terms were also presented in this chapter.

Chapter 2 provides the theoretical framework that guided the study. It also presents the literature review based on instructional materials in teaching Biology, the importance of improvised instructional materials in teaching biology, and academic achievement in Biology and the factors influencing it.

Chapter 3 presents the research method used to collect data in the study. It also presents the research design, the population, the sampling methods, pilot study, research instrument, the data collection procedures, data analysis, and ethical considerations.

Chapter 4 presents the data analysed from the tests and the focus group discussions.

Chapter 5 discusses the study's findings that were presented in Chapter 4 in relation to the test's findings and focus group discussions' themes that emerged.

Chapter 6 presents the summary of the study's findings, conclusion and recommendations based on the study's findings.

1.13 Conclusion of the chapter

This chapter presented the background of the study, statement of the problem, research question and hypotheses. In addition, the significance of the study, and the limitations

and delimitations of the study are also presented in this chapter. Also, the definitions of terms used in the study were presented in this chapter. The next chapter presents a literature review and a theoretical framework.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The theoretical framework that guided this study is presented in this chapter. It further presents the literature review on instructional materials in teaching biology, the importance of improvised instructional materials in teaching Biology, and the factors influencing academic achievement in Biology.

2.2 Theoretical framework

According to Osanloo and Grant (2016), a theoretical framework is a ground from which the studies' knowledge is built. They further stated that the theoretical framework acts as an anchor that the researcher should use to generate a problem statement, the significance of the study, and to discover related literature. Therefore, a deeper and thoughtful understanding of the chosen theory is required. In this case, this study is informed by the Condition of Learning Theory, which was developed by Robert Gagne in 1965. The Condition of Learning Theory maintains that "There are different types of learning outcomes, each of which is best achieved through its specific instructional design, but also that there is a set of steps required every learning environment" (Gagne, 1965, as cited in Zimmerman & Schunk, 2002, p. 28).

According to Richey (2000), the Condition of Learning Theory is cemented around four principles namely:

1. Different instruction is required for different outcomes.
2. Events of learning operate on the learners in ways that constitutes the condition of learning.
3. The specific operations that constitutes instructional events are different for each different learning outcomes.

4. Learning hierarchies define what intellectual skills are to be learned as a sequence of instruction. (p. 94)

As a result, nine instructional events and corresponding cognitive processes have been outlined in the theory (Richey, 2000). However, these events must satisfy and avail the needed conditions for learning and aid a program for designing instructions and choosing relevant instructional materials (Twitchell et al., 1990). The table below shows Gagne's nine events of instructions.

Table 2.1

Gagne's 9 events of instruction (Gagne & Medsker, 1996, as cited in Ullah et al., 2015, p. 536).

EVENTS	**ACTION**	**MENTAL PROCESS**
1. Gaining attention	Use questions, pictures, or relevant scenarios	Reception
2. informing learners of the objective	Tell learners what they will be able to do after learning	Expectancy
3. stimulating recall of prior knowledge	Ask for recall of prior relevant knowledge	Retrieval to work memory
4. Presenting the content	Structured display of the contents to be learned	Selective perception
5. Providing learning guidance	Use mnemonics, elaborations, pictures, graphs	Semantic encoding
6. Electrifying performance	Ask learners to perform	Responding
7. Provide feedback	Give feedback	Reinforcement
8. Assessing performance	Additional learners' performance with feedback	Retrieval & reinforcement
9. Enhancing retention and transfer	Ask learners to apply knowledge in real life scenarios	Retrieval & generalisation

Alluh et al. (2015) concluded that Gagne's nine events of instruction bring about a significant framework that can be used in teaching sessions and can lead to

improvement in teachers as well as in learners due to better understanding. This study investigated the effects of using improvised instructional materials on learners' achievement. Thus, this theory fits this study in the context that it emphasized on gaining learners' attention as one of its instructional design events which can be achieved by providing a proper introduction that can be assisted with instructional materials such as pictures, simulations or any other stimulating instructional materials. Furthermore, its fifth instructional design event further emphasized that teachers should provide learning guidance by using observable instructional materials to best achieve the learning objectives (Cooperman, 2007). However, due to lack of instructional materials in schools in remote areas in Namibia, teachers tend to come up with improvised instructional materials to mitigate the problem at hand (Uugwanga, 2020). In doing so, the teacher can then make use of Conditions of Learning nine events of instructional design to come up with the improvised instructional materials that best suit the content, learners, and the environment. Furthermore, when a teacher is developing the desired improvised instructional materials, he/she is responding to an environmental condition which is the lack of standard instructional materials. This is in parallel with the Biological Science Curriculum Study (BSCS) 5E model which aim to solve instructional design problem in science and to ensure that science lessons deliver what they are intended to deliver by applying; engagement, explanation, elaboration, and evaluation (Bybee et al., 2006).

2.3 Literature review

2.3.1 Importance of improvised instructional materials in teaching of Biology

A study conducted in the Khomas region, Namibia about factors affecting grade 12 learners' academic achievement (Muyoyeta, 2015) found that shortcomings in instructional materials (specifically standardised instructional materials) contributes to

low academic achievement of learners in NSSCO Biology. In that study, some participants suggested improvisation of instructional materials as one of the methods they employ to mediate the lack of standard instructional materials in schools. Furthermore, Aina (2013) maintained that current monetary fluctuations and economic decline around the world continue to make it difficult for countries to properly finance education, thus schools lack standard instructional materials. However, alternative materials need to be found to meet the desired objectives (MoEAC, 2016). The ministry further urged teachers in Natural Sciences to be more innovative and skilful in coming up with their own instructional materials that are linked to practice.

Many science teachers who lack the skills and knowledge to design and set up interactional materials keep using theory persistently as the only learning method (Okeke, 2019). Johnson (2004, as cited in Ahmed, 2008) strongly advised that inadequacy of instructional materials should not be used as an excuse by teachers for normalising both poor performance in teaching and non-teaching. Piaget (1957, as cited in Ayua, 2011) asserted that science cannot be taught or learned with theory alone without practice, rather use them both to accommodate all learners based on their cognitive levels. Piaget further identified the four stages of cognitive development where he explained that children have different age levels of thinking at different ages, hence theory and practice together help children to acquire more knowledge than each one on its own.

Bomide (2007) classified improvised instructional materials into two types based on their material purposes, namely, Role substitution – the modification of the standard instructional materials; and Role simulation – designing an actual instructional material due to a lack of the needed instructional materials. In Biology, improvised instructional materials promote the use of technology in science, hence making lessons

lively and fun (Nnorom & Obianuju, 2021). Moreover, improvised instructional materials enforce creativity in teachers and learners, thus they function as a foundation for indigenous technology and innovation in the subject (Nnorom & Obianuju, 2021). Furthermore, improvised instructional materials pave the way to minimise equipment/apparatus loss and the birth of an inexpensive strategy for broadening the scope of enquiry (Ahmed, 2008).

Attah (2014, as cited in Ibe et al., 2021) stated that improvised instructional materials have proven to be more helpful to learners in improving their performances in subjects than standard materials could do. He reasoned that improvised instructional materials promote hands-on learning, and it is also important for learners' high retention of what they learned. A couple of things can influence how a learner learns and their retention of what they have learned in a subject; this includes prior knowledge, instructional design, the teacher, and the instructional materials techniques used (Popova et al., 2014). Similarly, Mboto et al. (2011) found that improvised instructional materials turn out to be more effective for learners, helping them to remember conceptual ideas compared to other materials. Improvisation is one of the efficient ways of gaining knowledge by doing, where learners have the chance to explore their surrounding and make use of available media in their society (Ndihokubwayo et al., 2018).

A study conducted by Dwinando et al. (2020) recommended that teachers should come up with improvised instructional materials that are based on societal context rather than national context, for learners to get more knowledge about their local wisdom. Different researchers (Chinna, 2010; Ibrahim et al., 2019; Obi & Obi, 2019) emphasised that improvisation in Biology encourages learners' ability of creativity, it increases learners' familiarity with materials in their society and strengthens enquiry, discovery, and experimental methods in science. According to Iji et al. (2014),

improvised instructional materials bring more intense, enjoyment, as well as full participation of learners in the lesson. However, many teachers struggle to set up and choose the right improvised instructional materials when they are teaching Biology due to a lack of training from responsible institutions (Ahmed, 2008; Mboto et al., 2011; Obi & Obi, 2019). Therefore, teachers need to be trained on how to improvise using real alternative materials that they can find locally in their areas, hence more workshops need to be initiated (Ibe et al., 2021; Obi & Obi, 2019). However, safety should be prioritised when using these improvised instructional materials in demonstrations and practicals, hence their materials should not be hazardous to learners in any way (Ibe et al., 2021).

2.3.2 Instructional materials in teaching of Biology

Biology as part of Natural Sciences serve as a subject through which one can discover the mysteries of the physical world and its basic laws; therefore, teachers are encouraged to create a science classroom that is creating excitement and promoting learning with classroom displays and proper instructional materials (MoEAC, 2019). Previous literature indicated that teaching should not be seen as a pool of knowledge being passed on to learners in a subject but rather include professional competency within facilitators using instructional materials, methods and strategies that influence learners' behaviours (Sale, 2016). Furthermore, Ibrahim et al. (2019) stressed that in Biology, teaching and learning cannot occur effectively if there are no engagements between learners, teachers, and the environmental resources. Hence, the biology curriculum must be drawn up in such a way that can allow teachers as facilitators to plan their lessons and give activities that are learner centred.

According to Amadioha (2009), instructional materials refer to other ways of communications that a subject teacher can use to cement content in the process of

teaching and learning. Nwike and Catherine (2013) defined instructional materials as "different teaching aids or apparatus which a classroom teacher employs to facilitate his or her teaching for the achievement of the stated objectives" (p. 103). These materials consist of low objects that learners and teachers are locally familiar with (Ibrahim et al., 2019). The Natural Sciences Policy Guide (MoEAC, 2019) stated that different prescribed textbooks and laboratory materials that teachers and learners can use as teaching and learning materials are available in government catalogues. However, it is the responsibility of the government and school to provide suitable teaching materials (MoEAC, 2019).

Effective teaching should not only boost learner's interest in the subject, but their performance in that subject too. Therefore, teachers must use instructional materials when delivering lessons to boost learner's interest in the subject (Nwike & Catherine, 2013).

> Instructional materials constitute of tangible products, which can be used by learners. During such usage, a learner interacts with the material. Such interaction may entail that a leaner manipulates the instructional material and expresses his/her views about the problem and idea encapsulated in the material. Then, any feedback obtained from such usage informs the teacher (which is the source) the extent to which a learner has attained an instructional objective. (Amadioha, 2009, p. 61)

Although inadequate instructional materials still is one of the main challenge in Namibian schools, the government through the MoEAC must aim to solve that problem by availing more funds to schools to improve learner's achievement in subjects (Hamunyela et al., 2022). Different researchers (Amadioha, 2009; Amos et

al., 2022; Baidawi, 2016; Ibrahim et al. 2019) asserted that instructional materials are important in such a way that they provide a high determination because of their experience to realistic object; therefore, it leads to permanent learning. Bulusan (2019) urged that it is important for the instructional materials to be authentic in a way that is relates to the learners' environment and seek to get learners' interest. Furthermore, science facilitators and learners agreed that instructional materials are convenient in a way that they support the teaching process as well as academic gain; therefore, science teachers must use improvised instructional materials to enhance knowledge gain (Asrizal, 2018). However, Amos et al. (2022) cautioned that "instructional materials must be designed and chosen based on the subject objectives, the learners' characters, and the extent to which the materials expected to be practical" (p. 21).

Instructional materials are divided into three groupings based on the characters they present: "audiovisual instructional materials, audio instructional materials, and visual instructional materials" (Amos et al., 2022, p. 22).

2.3.2.1 Audio-visual instructional materials

On its own, audio-visual is a combination of view and hearing media (Hamdani, 2011 as cited in Fuady & Mutalib, 2018). When using audio-visual as instructional material, the teaching and learning process becomes easier, more understandable, and optimal for learners, therefore its effectiveness in teaching can be seen through learners' enjoyment during the instruction (Fuady & Mutalib, 2018). According to Ashaver and Ingyuve (2013), audio-visuals help teachers in solving physical problems when it comes to presenting the subject content. That is to say, the difficulty of distance and communication would be broken by bringing the necessary slides, filmstrips, and projectors about a certain culture or country into the classroom. Furthermore, a study conducted by Olawale (2013) about the use of instructional materials for effective

learning of Islamic studies showed that “the use of audio-visuals in teaching leads to learners’ improvement in a subject by seizing picture subjects. In the study, the results showed that the experimental group achieved 83.24% compared to the control group which managed only to achieve 49.43%.” (p. 31). However, Fuady and Mutalib (2018) cautioned that audio-visual should be used properly to avoid misinterpretation and skewed attention from learners that leads to zero understanding.

According to Amos et al. (2022), audio-visual instructional materials help with hearing, sight, and touch senses. Further, line sound film, television, and tape recorders are some of the audio-visual devices that teachers can use in Biology during the instruction process. Ojelade et al. (2020) explained that audio-visuals are very influential on the learner’s achievement in sciences. They cause learning experiences to be more live because of the images and animations that make content easier to comprehend (Ojelade et al., 2020). Based on that, it is therefore recommended that teachers need to be encouraged more to use audio-visual as instructional materials. Also, the government and its educational institutions must provide materials and workshops that can train teachers about these types of instructional materials (Ojelade et al., 2020).

2.3.2.2 Audio instructional materials

Audio instructional materials appeal to the sense of hearing only, and they can be radio, audio tape, and tape recording (Oladejo at el., 2011). In addition, Amos et al. (2022) emphasised that audio instructional materials are important due to their capability to be used for many purposes starting from transferring verbal information to enhancing the intellectual and motor ability in learners. They further stressed that audio materials are easy to use, and they are inexpensive, hence teachers can easily acquire them.

2.3.2.3 Visual instructional materials

Amos et al. (2022) described visual materials as devices that enhance learning by using the body senses of sight, touch, and scent; for example, chalkboard, charts, posters, and graphics. Baidawi (2016) explained that the presence of visual materials provides a complete learning experience which then brings about creativity in learner's thoughts, of which they can eventually use to express themselves. Furthermore, Baidawi (2016) outlined that there are four types of visual materials: (a) Printed materials, which include any material that is printed such as books and posters; (b) Realia materials, based on showing learners real objects in the classroom such actual animal, plants leave or slides; and (c) Overheard transparency (OHT) and Liquid-crystal display (LCD), which involves using video to explain the content.

2.3.3 Factors influencing academic achievement in Biology

Academic achievement represents subject objectives that determine the extent to which a learner has performed in a certain instructional environment, school, college, and university (Steinmayr et al. 2014). In most countries, school systems are structured in a way that they define cognitive goals such as critical thinking and understanding across almost all subject areas (e.g. science, mathematics, history); therefore, the academic achievement should be seen as a multifaced exercise which consists of a few domains (Steinmayr et al., 2014). Moreover, Kpolovie et al. (2014) defined academic achievement as "the ability of the student to study and remember facts and being able to communicate his knowledge orally or in a written form even in an examination condition" (p.73). According to Adak (2017), academic achievement is the performance or the scores that a learner gets against the main objectives in a specific theme or topic. Juned et al. (2020) described the academic achievement as a construct goal that intends to close the gap between the intended objectives of Biology

and general life objectives. Steinmayr et al. (2014) further indicated "that academic achievement can be measured using the Grades Point Average (GPA) or any type of assessment, of which most of them are designed to determine the progress of a learner to the next grade" (p. 12).

Wiesnerova and Vojtkova (2012) defined assessment as a means of gathering information about the learner's progress in the acquisition of knowledge and understanding in teaching and learning. According to MoEAC (2018), learners doing Biology in grade 11 need to be assessed based on the assessment objectives in the subject. The same document further stated that the assessment must aim to engage a learner at a personal, social, economic, environmental, and technological level. Therefore, learners must be able to illustrate the assessment objectives based on the subject content and skills outlined by each assessment objective. In addition, assessment must have the responsibility of making sure that learners are able to communicate clearly and logically (MoEAC, 2018). The MoEAC (2018) indicated that "different types of assessment such as, formative assessment, summative assessment, continuous assessment, and diagnostic assessment can be used in Biology to grade learners (A, B, C, D, E, F or G) **A** being the highest and **G** the lowest" (p. 28).

Formative assessment, this assessment is ongoing, it is what a teacher does daily, and it involves giving learners feedback on their progress in the learning process (Wiesnerova & Vojtkova, 2012). This type of assessment does not only give learners feedback, but it also helps teachers to know if their strategies, methods, and instruments are effective towards the assessment objectives (Wiesnerova & Vojtkova, 2012). Meanwhile, summative assessment is the assessment that is applied at the end after a period of teaching and learning, they can be written at the end of the academic term (Kibble, 2017). Summative assessment is mostly used to judge learners. For

instance, it can be used as a tool of promoting them from one course to another (Kibble, 2017). Diagnostic assessment focuses on measuring learner's prior knowledge about the subject, and to avail information about a learner's cognitive strength and weaknesses (Leighton & Gierl, 2007).

Different researchers (Hamunyela et al., 2022; Muyoyeta, 2018; Nghishongwa, 2017) discovered that different factors continue to influence learner's achievements in subjects. These factors range from learner-based factor (indiscipline, lack of motivation, and loss of interest) to teacher-based factors (teacher's low expectation, teacher's workload, teacher's competency, and methods used), and school-based factors (lack of instructional materials, and large syllabus content for Biology).

2.3.3.1 Teacher based-factors and school-based factors.

A study conducted by Kimani et al. (2013) in Kenya discovered that "teachers largely influence learners' academic achievement, and a teacher's workload is one of the factors that affect a teacher's effectiveness in teaching and learning" (p. 67). Similarly, Verner et al. (2022) concluded that "high workload and teachers' narrow knowledge about the subject content are a few of the challenges contributing to a low-performance rate of learners in NSSCO Biology in //Kharas region" (p. 14). Heavy workloads cause teachers not to provide enough activities, tasks, and tests to learners. As a result, learners got to perform below the expected objectives in that specific subject (Gwambombo, 2013). Moreover, Gwambombo (2013) uncovered that allocating a large group of learners to a teacher causes a heavy workload, and it is mainly caused by a lack of qualified teachers and monetary means in education systems.

According to Fortsch et al. (2018), a teacher's professional knowledge influences learners' performance in a subject. Therefore, having enough academically and

professionally qualified teachers in the education system is very important because the knowledge they possess can be crucial in ensuring high academic achievement of learners in their subjects (Aina & Olanipekun, 2015). Hence, it is recommended that proper and informative workshops need to be facilitated, together with consultations with retired experienced teachers on how to overcome challenges faced by the current teachers and schools (Aina Gwambombo, 2013; Kimani et al., 2013; Aina & Olanipekun, 2017).

2.3.3.2 Learner based factors.

The MoEAC (2016) encourage teachers as implementers to enforce the learner-centred approach, where learners are more involved and responsible for their studies. Despite that call, different learner-based factors continue to hinder teaching and learning, which later consequently affect learners' academic performance in schools (Muyoyeta, 2018). Tus et al. (2020) highlighted that academic achievement of learners varies based on each learner excess energy he/she puts in; thus, their ability and action determines their progress in education. Discipline and lack of motivation and support from parents stands as some of learners related factors that has an impact on their academic achievement (Siachifuwe, 2017).

2.3.3.3 Learner's discipline

According to Ehiane (2014), discipline portrays the school in a good image by producing products that are ready for the future; therefore, bad behaviour is often eliminated when learners are well mannered. "

> The implementation of effective discipline at school is key for the learners in the journey to adulthood. Parents often have no choice but to enrol their

children in a school with good discipline, which often leads to better academic achievement performance (Ehiane, 2014. p. 181)

Every nation grows with the force and brilliant minds of their young generation; hence it is of significance to see to it that the young generation is taken care of with a proper education system and are prepared and preserved for the near future (Ofori et al., 2018). In contrary to what is expected from the young generation, Muyoyeta (2018; Neshila, 2018; Verner et al., 2022) found that the indiscipline in learners contributes to poor academic achievement of learners in schools. In their study, Verner et al. (2022) point out that some participants responded with disappointment regarding learners who misbehave during instruction, where some even go to the extent of walking out of the class and dodging pre-arranged classes.

Furthermore, Ofori et al. (2018) asserted that "a classroom where a teacher is unable to maintain law and order will be chaotic. This may lead to low academic achievement and unhappy learners" (p. 110). Ofori et al. (2018) further indicated that "major indiscipline in schools is caused by broken homes, poor financial support from parents, wrong influence from media, bad examples set by peers, and parents unable to recognise and help children psychologically and emotionally" (p. 7). In addition, Njoroge and Nyabuto (2014) discovered that the indiscipline of learners hinders the learning process, leading to missed opportunities for both disciplined and indiscipline learners and alteration of learner-teacher relationships.

2.3.3.4 Lack of motivation and loss of interest.

Motivation remains one of the key factors that drives people toward their goals, and mostly, it does not matter what parcel of their life (Singh, 2011). Singh (2011) further explained that academic motivation plays a major role in a learner's academic success

with no regard to age. At the same time, learners tend to harness self-belief, value and ability when motivated. Thus, learners that are highly motivated are more likely to have an increased academic achievement level and a rare dropout chance. Mauliya et al. (2020) noted that a absence of parental motivation causes a child to lose focus, leading to a child losing interest in his/her study. Therefore, parents and teachers need to motivate learners in a way that can satisfy learner's psychological needs, which in turn sets the foundation for learners to set their goals (Alamer & Lee, 2019).

2.4 Conclusions

This chapter, first, discussed a theoretical framework which informed the study, which is the Condition of Learning Theory developed by Robert Gagne in 1965. The theory presented that different learning objectives require different instructional designs that need to be developed into practical steps. Also, the designing of instructions must consider learners and the environment where teaching and learning is taking place. Gagne's Condition of Learning theory provided the researcher with the necessary tools and concepts to explain and describe the effects of improvised instructional materials on learners' academic achievements in Biology.

Secondly, this chapter reviewed literature related to instructional materials in the teaching of Biology, the importance of improvised instructional materials in the teaching of Biology, and academic achievement in Biology and the factors influencing it. Generally, most literature reviewed had indicated how instructional materials are important in the teaching and learning process and had noted that its absence might contribute to low performance of learners in a subject. It should also be pointed out that the majority of literature on improvised instructional materials is conducted in a different teaching context. However, a lot focused on solving the lack of standard instructional materials in schools with the use of improvised instructional

materials. Some focused on the importance of improvised instructional materials in teaching and learning. However, little is done on understanding the effect of improvised instructional materials on learners' achievement in Biology, more specifically in the Namibian context. hence, the current study is justified to provide a contextual knowledge of how Biology teachers in a Namibian school setting can use improvised instructional materials to influence academic achievement. Therefore, this study sought to fill the gap of knowledge by investigating the effects of improvised instructional materials on Grade 11 learner's academic achievement in Biology in Omuthiya circuit. Having reviewed the literature. In the next chapter, methodology of this study is presented.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This chapter presents the methodology of the study. It describes the research design, the population, and research instruments used for data generation. Procedures of data collection, data analysis, and the ethical considerations are all presented in this chapter.

3.2 Research paradigm

This study used the mixed method approach, which was underpinned by the principles of the pragmatism paradigm. According to Kivunja and Kuyini (2017), truth cannot be found solely by carrying out scientific research, nor can it be acquired through social reality alone as is stipulated by the Positivist and Interpretivist paradigms. Kaushick and Walsh (2019) stated that pragmatists based their idea on a proposition which called for the creation of a worldview that can allow the researchers to use approaches that suit well their research problems. Rahi (2017) stated that "pragmatism plays an important role in problem-solving by identifying the strength of the study with the use of the mixed-method approach" (p.5). Therefore, this study revered the pragmatism paradigm helped this study by combining both qualitative and quantitative principles in order to understand the effect of improvised instructional materials on Grade 11 learners' achievement in Biology.

3.3 Research Design

In this study, a mixed-method research approach was employed to investigate the effects of improvised instructional materials on learners' academic achievement in Biology. In emphasis, a mixed method approach constitutes the incorporation of the two research designs (qualitative and quantitative approaches) in acquiring data of the study (Cresswell, 2014). Taherdoost (2022) alluded that based on the study, researchers

usually choose a mixed-method approach due to its ability to provide a clear understanding of the subject under study. A quantitative research approach was used to capture the data addressing the effect of using improvised instructional material on experimental group learners' achievement in Biology. The qualitative research approach was used to capture learners' experiences and views on the effect of using improvised instructional materials in teaching and learning Biology, as well as discover ways in which improvised instructional materials contribute to learners' achievement in Biology.

A quasi-experimental research design of a pre-test and post-test was used to create a cause and effect among the relationship between improvised instructional materials and learners' academic achievement in Biology. A quasi-experimental design involves comparing the outcomes of a group that received a treatment to the one that has not received a treatment (Thyer, 2012). In this study, learners from the same classroom were randomly divided into two equal groups, group **A** (experimental group) and group **B** (control group). This was done by picking folded pieces of papers written learners' names from a jar after mixing them up thoroughly. The first fifteen names picked were placed in group A, while the remained fifteen were placed in group B.

On the other hand, to gather qualitative data for the study an interpretivism approach of focus group discussions were used. According to Alharahsheh and Pius (2020) interpretivism is more concerned about getting an in-depth data about the phenomenon, with a belief that human beings should be explored in more than one way for a researcher to gather quality data. Focus group discussions were used to get an in-depth understanding of the Grade 11 learners that were in the experimental group about their views and experiences when they were being taught the topic 'Gas exchange in humans' with improvised instructional materials. Those participated were

chosen based on their own desires to take part in the focus group discussions. In total, ten (10) learners from the experimental group took part in the focus group discussions. This study aimed to collect data that can determine the effect of improvised instructional materials on Grade 11 learners' achievement in Biology.

3.4 Population

The targeted population was all learners (approximately 758) in all nine secondary schools in the Omuthiya Circuit, Oshikoto Region.

3.5 Sample

One secondary school with a Grade 11 class of Biology from a total of nine secondary schools in Omuthiya Circuit, Oshikoto Region was purposively selected. The researcher purposively selected the Grade 11 learners doing Biology from the selected school as participants in this study. This was done because there is only one Grade 11 class at the selected school, which consisted of thirty learners (30) in total. The researcher further randomly divided the participants into two equal groups namely: the experimental group (A) and the control group (B). To ensure validity, learners were placed in these two groups randomly by writing each learner's name on a piece of paper which was then folded, mixed up and placed in a jar. The researchers then pick out the first fifteen papers one by one and placed those learners in group A. The remained fifteen names were placed in group B. learners were randomly assigned to this groups to make sure that each learner had an equal chance of being in either group. Each group had fifteen learners to ensure equality in terms of numbers of learners per group. The experimental group was taught by the researcher with improvised instructional materials (a breathing model and a structure of an alveoli) (see appendix C) plus a textbook and teachers' notes. While the control group was also taught by the researcher with a textbook and teachers' notes only. Furthermore, the ten learners from

the experimental group were randomly chosen on a voluntary basis in order for them to take part in the focus group discussions.

3.6 Research instruments

The study used a Biology Achievement Test (BAT) (see appendix A) as well as focus group discussions (see appendix B) that were developed by the researcher. The two instruments were validated by a senior education officer for Biology in the Oshikoto region as well as by the study supervisors who made corrections that were effected in the final instruments. To establish validity and reliability, a pilot study was carried out.

3.6.1 Achievement test

Tests can be used for different purposes; however, their usefulness depends on how the purpose of testing matches the specific aims it was developed for (Kubisyn & Borich, 2016). Further, Kubisyn and Borich (2016) asserted that tests make it easy to compare learners by providing prior knowledge information that can be used to determine what a learner could do in the research.

In this study, a BAT on the topic of 'Gas exchange in humans' was given to both groups **A** and **B** at the beginning of the study as both learners' groups were at the same level of understanding with regards to the topic of 'Gas exchange in humans'. The researcher made an intervention by teaching group **A** for six weeks in lessons of 50 minutes with improvised instructional materials (a breathing model and an alveoli structure made from boxes), textbooks, and teacher's notes. Group **B** was also taught using the same lessons for the same duration, but with traditional instructional materials only (teachers' notes and textbooks). After both two groups were taught by the researcher, a post-test (same BAT) was then administered again to both groups after an intervention.

3.6.2 Focus group discussions

Kallio et al. (2016) stated that "a focus group discussion is one of the most used methods of collecting data due to its ability of versatileness and flexibility" (p. 9). A focus group discussion is a discussion that is more on exploring the participants' in-depth understanding of the topic, and it achieves that using a guide that is mostly focused on providing a specific pattern (Cresswell, 2014; Ruslin et al., 2022, p. 18). Galleta (2012, as cited in Kallio et al., 2016) emphasised that the focus group discussion is more favoured to other methods because it successfully allows reciprocity between the participants and the facilitator.

Based on the above-mentioned descriptions and definitions, a focus group discussion was used to carry out a face-to-face discussion with ten (10) Grade 11 learners who were part of the experimental group. The ten learners from the experimental group list were selected randomly on a voluntary basis and divided into two focus groups (five learners in each). The discussions were conducted after the intervention was completed. This was done after school hours, and it took 20-30 minutes. Those that could not take part in the discussions were excused to go home while the discussions were going on. Through the focus group discussions, the researcher aimed to establish learners' in-depth understanding and their views on the use of improvised instructional materials in teaching Biology, and the possible effects it had on their achievement.

3.7 Data collection procedures

The researcher obtained an ethical clearance certificate to collect data from a Decentralised Ethics Committee (DEC) of the University of Namibia (see Appendix D). Furthermore, the researcher obtained permission from the Director of Oshikoto Education Directorate, and the participant school's principal to conduct the research. The researcher also explained the purpose and importance of the study to the

participants and the data collection procedures. In addition, the researcher made sure to get assent from learners before the intervention. It was also made clear to the learners at the beginning of the study that the researcher will be responsible for teaching both two groups, and all lessons or any other activities related to the study were to be conducted after school hours. On the first day, the researcher administered a 40-mark Biology Achievement Test (BAT) as a pretest for one hour to both groups in their respective class. Thereafter, each group was taught eight lessons in six weeks after school hours by the researcher, and these lessons covered the learning objectives such as the difference between breathing and respiration, features of gaseous exchange, and the process of inhalation and exhalation. During these lessons, the experimental group participants were presented with an improvised breathing system model that showed them what happens to the intercostal muscle, ribs, chest and diaphragm when a human beath in or out (see Appendix C). Additionally, an improvised model that shows the structures and features of gaseous exchange in an alveolus (see Appendix C) was used for the same group. Although the lesson objectives were the same in both groups, the control group was only taught with the usual traditional materials methods of diagrams on the board, textbooks, and teacher's notes. To ensure that the two group do not influence each other, each group was taught separately by moving the group that the researcher is not attending to at that specific time to any empty classroom available. After six weeks of intervention, the intended content in all groups was covered and the post-test of the same Biology achievement test was then administered.

Three days after writing the post-test, the ten Grade 11 learners from the experimental group were randomly selected on the voluntary basis to participate in a focus group discussion. For confidentiality purposes, the researcher used pseudonyms (L2, L6, L8,

L9, L10, L11, L12, L13, L14, and L15) during the intervention as references in the discussions. The discussions was conducted in the Grade 11 classroom after school hours and lasted for 20-30 minutes. In addition, an audio recorder was used to record the discussion sessions in order to maintain the validity and credibility of the discussion sessions to avoid biases in the process of transcription.

3.7 Pilot study

A pilot study was conducted by the researcher three weeks before the study to ensure that the questions in the research instruments (BAT and discussion guide) were clear and valid to all participants. According to In (2017), a pilot study must be carried out in a way that reflects the procedures of the actual study; hence, it must validate the study's feasibility by examining the inclusion and exclusion of participants. Moreover, Lowe (2019) asserted that the primary purpose of a pilot study should be to prevent a researcher from selecting a large-scale study that he/she has no knowledge about. Therefore, in this study, the researcher piloted the research instruments to forty (40) participants in one of the secondary schools in Omuthiya circuit, Oshikoto region. However, the selected school for piloting was not part of the study.

During this phase, some adjustments were made to the research instruments. For instance, the duration of writing was changed from 50 minutes to 60 minutes to provide enough time for the participants to answer the test questions. The line spacing was also increased from 1.5 to 2.0 (double lines) to provide enough space for writing answers in response to questions in Section B. It was also noted that a picture that was used in Question 2 Section A was not clear enough to the participants; therefore, it was replaced with a new clear picture.

3.8 Data analysis

Data analysis is about converting collected data to understandable information; however, such data must be prepared prior to being used in data analysis (Taherdoost, 2022).

3.8.1 Quantitative data

The quantitative data collected was analysed and presented using descriptive statistics (mean). Furthermore, an Excel spreadsheet for the paired and unpaired t-test was used to test the effects of improvised instructional materials on learners' academic achievement in Biology. An alpha value of 0.05 was used to determine the findings of the study based on the two hypotheses stated earlier.

3.8.2 Qualitative data

The qualitative data from the focus group interview was transcribed. The transcription was done by carefully and repeatedly listening to the audio recordings as recommended (Bailey, 2008; Cresswell, 2014). A thematic approach was used to analyse data where issues arising were coded and organised into themes.

3.8.3 Triangulation of Data

This study followed the principles of a mixed-method research approach. Two sources of data, namely, quantitative (pre-test and post-test) and qualitative (focus group discussions), were broadly compared for triangulation purposes in order to ascertain whether improvised instructional materials have a positive effect on the Grade 11 learner's achievement in Biology. The reason for the triangulation of data was to ensure that major biases arising from the use of a single source are limited. Caillaud, et al. (2019) emphasised that triangulation is restricted to hypothesising that results from one method are credible if they are correlated with results received utilising

another method. They added that triangulation also provides an opportunity for data validation, comprehensive data and a comprehensive understanding of the issue under study.

3.9 Ethical consideration

According to Hassan et al. (2021) the value and behaviours of a researcher are guided by research ethics. Ketefia (2015) explained that research ethics help to underlie the principles that aimed to protect human subjects from any sort of harm that my come with academic research. “It is important for the researcher to try to think about any adverse effects the study could possibly have on any of the participants” (Dooly et al., 2017. p. 351). Therefore, in this study in order to uphold to the research standard and principles the researcher obtained a clearance certificate from DEC (see appendix D), a permission letter from the Postgraduate Office, and all other relevant authorities including a permission letter from the director of education for Oshikoto region (see appendix E). The participants were assured of confidentiality and the information collected would only be used for this study. The researcher also informed the participants that they were free to withdraw at any time if they wished to without any implications regarding their daily activities and services at school. Furthermore, parental consent letters were provided to learners since all participants were minors. However, learners were also presented with assent letters. Hence the study only commenced when all the participants signed assent letters and signed parental consents were received by the researcher. Also, the participants were informed that the data collected were to be stored in a personal computer of the researcher with the password that only the researcher knowns of. Data and participants information in hard copies will be stored in a researcher’s personal locker at the researcher’s resident. After two years the data will then be discarded.

3.10 Conclusions

In this chapter, the methodology of the study was presented. The research approach used was a mixed method, using a population of all nine secondary schools in the Omuthiya circuit. More so, the chapter discussed the sample and sampling procedures, the research instrument, and the data collection procedures that were adopted in the study. The information regarding the pilot study is also presented in this chapter. Further, ethical consideration is also presented in this chapter. In the next chapter, the findings are presented.

CHAPTER 4: PRESENTATION OF THE FINDINGS

4.1 Introduction

This chapter presents the findings of the study. The purpose of the study was to investigate the effect of improvised instructional materials on Grade 11 learner's academic achievement in Biology at a selected school in the Omuthiya circuit, Oshikoto region. The chapter commences with the participants' biographical information and concludes with the presentation of the main findings.

4.2 Biographical information of the participants

The biographical information of the participants featured in this study is presented in Table 4.1 below.

Table 4.1

Biographical information of the participants

Participants Information		**Groups**	
Gender		**A (experimental)**	**B (control)**
Male		9	10
Female		6	5
Total		**15**	**15**
Age categories	15-16	0	1
	17-18	8	6
	19-20	6	6
	20-21	1	2

In total, 30 Grade 11 learners from the selected school participated in this study. Although the participants were chosen randomly based on their natural classroom

setting, Table 4.1 indicates that the study had more male participants (19) than female participants (11). This could be because there were more male learners than female learners in Grade 11 at the selected school. Table 4.1 also shows that most participants were aged between 17-18 years and 19-20 years, respectively.

4.3 Presentation of data

This section presents the findings based on the research questions that guided this study. The presentation of data includes the description, explanation, and making sense of the data collected. Since the study followed a mixed-method approach, the quantitative data from the pre-test and post-test were analysed with the use of descriptive statistics (means), an unpaired two-tailed t-test, and a paired two-tailed t-test. The qualitative data from focus group discussions were analysed with the use of a thematic analysis method.

4.4 Presentation of quantitative data

This section presents the findings from the Biology Achievement pre-test and post-test for the Experimental group and Control group.

4.4.1 Treatment strategies

In this study, the target population was 758 learners (approximately) from nine secondary schools in Omuthiya Circuit. However, a random sampling method was used to select one secondary school from the nine secondary schools with Grade 11. All 30 learners from one Grade 11 class from the selected secondary school doing Biology were selected as participants in this study. In this part of the study, a quantitative research approach was followed, using a quasi-experimental research design. The selected 30 learners doing Biology in grade 11 were further divided into

two groups, group A (experimental group) and group B (control group). Learners were purposively assigned into these groups.

A BAT about the topic of 'Gas exchange in humans' was administered to the two groups at the beginning of the study before the intervention as a pre-test. The BAT consisted of two sections, Section A – multiple choice questions and Section B – structured questions. The two sections were worth a total of 40 marks and were set to be answered in a duration of 60 minutes. After the pre-test, an intervention was then carried out for a period of 6 weeks, whereby each group was taught 'Gas exchange in humans' in lessons of 50 minutes. During the intervention, the Experimental group was taught the topic of gas exchange in humans using two improvised instructional materials (see appendix B): a breathing system model (made up of two balloons, two drinking straws, a clear plastic, and a two-litre plastic bottle) to illustrate inhalation and exhalation in humans. Another improvised instructional material used was an alveoli structure model (made from boxes and blank white papers) that was used to show the structure of the alveoli. On the contrary, the control group was taught the same topic but using the usual traditional instructional materials (textbook and teacher's notes) throughout the intervention.

After the intervention, the same BAT was administered again to the two groups (the experimental and the control group) separately to serve as a post-test. Thereafter, the data from the two groups (pre-test and post-test) were recorded for analysis purposes as follows in the next subsections.

4.4.2 Biology achievement pre-test results

This subsection presents the findings of the BAT for the Experimental group and Control group in their pre-test. Table 4.2 below shows the learners' actual scores from the pre-test.

Table 4.2

The actual pre-test scores of the Experimental and Control group

Experimental group				**Control group**		
Learners' Pseudonyms	***sex***	***Pre-test scores***		***Learners' Pseudonyms***	***Sex***	***Pre-test scores***
L1	F	15		L16	F	18
L2	F	17		L17	M	24
L3	M	17		L18	F	16
L4	M	12		L19	M	13
L5	M	19		L20	F	11
L6	M	8		L21	M	19
L7	M	18		L22	M	11
L8	F	22		L23	M	11
L9	F	12		L24	M	20
L10	M	22		L25	M	16
L11	M	19		L26	M	31
L12	F	15		L27	M	19
L13	F	20		L28	M	30
L14	M	18		L29	F	20
L15	M	23		L30	F	9
Mean score		**17.13**		**Mean score**		**17.87**

Table 4.2 shows the Experimental group and Control group pre-test actual scores which are then translated into a bar chart in Figure 4.1 below to compare the two groups' pre-test mean scores.

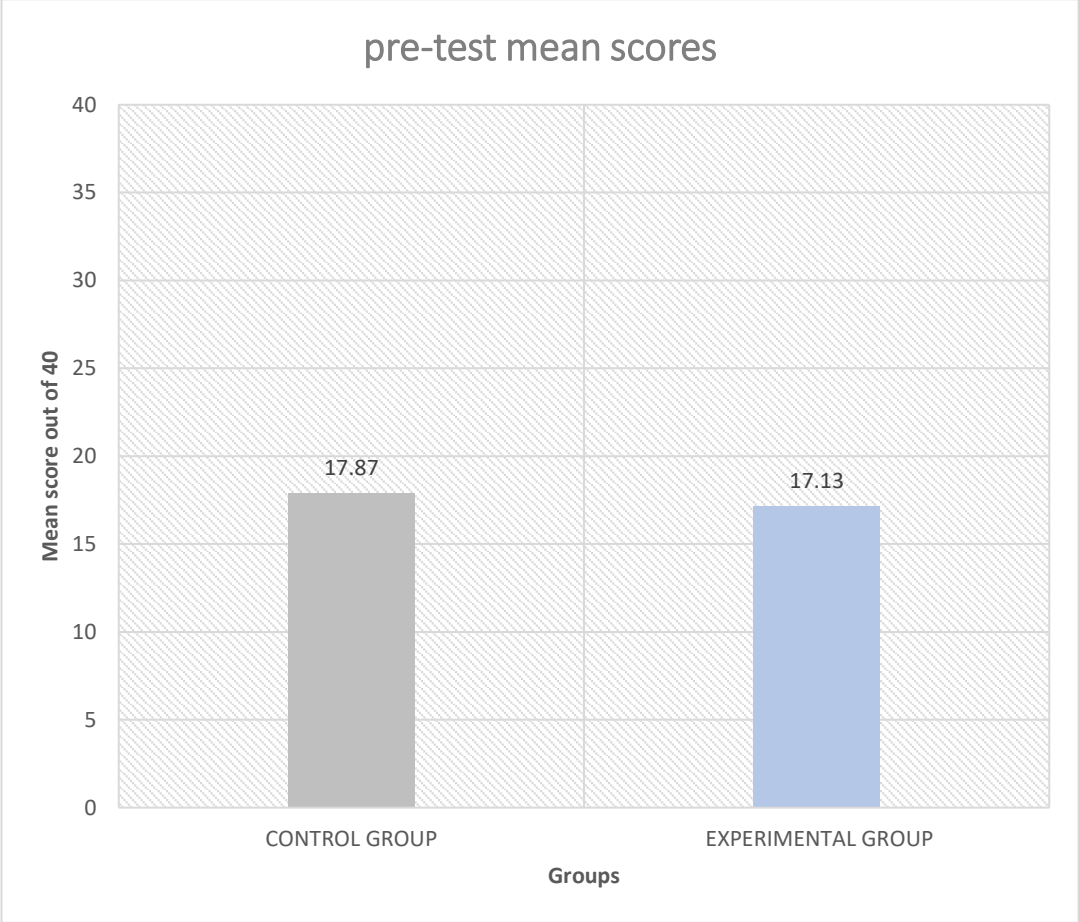


Figure 4.1. Comparison of the pre-test scores

Figure 4.1 shows that the control group mean score in the pre-test is slightly higher than that of the Experimental group with a difference of 0.74 scores. An unpaired t-test to determine whether this difference is statistically significant or not is presented in Table 4.3 below, which tested the following hypotheses:

H_0: There is no statistically significant difference in the Biology Achievement test pre-test scores of the experimental group and control group.

H_1: There is statistically significant difference in the Biology Achievement test pre-test scores of the Experimental group and Control group.

Table 4.3

Biology achievement test pre-test statistics of the experimental and control groups

Summary of test statistics (pre-tests)		
	Experimental	Control Group
Observations	15	15
Missing	0	0
Mean	17.13	17.87
Median	18	18
Range	15	22
Mode	15	11
Standard Deviation	4.17	6.65
Variance	17.40	44.27
T-value	0.72	
T-critical value	2.06	
Degree of Freedom (df)	24	

As indicated in Table 4.3, at an alpha value = 0.05 (95% level of significance) and degree of freedom (df) =24, the t-test carried out calculated a t-calculated = 0.72 and t-critical = 2.06. Therefore, it can be concluded that H_0 is valid, which stated that: there is no significant statistically difference in the Biology Achievement tests pre-test score of the Experimental and Control groups.

The next subsection present comparison of the post-test scores of the Experimental group and Control group in the Biology Achievement test.

4.4.3 Biology achievement test post-test results

This subsection presents the post-test results for the Biology Achievement test that was administered to both the Experimental group and Control group. Table 4.4 below shows learners' actual scores from the post-test.

Table 4.4

The actual post-test scores of the Experimental and Control groups

Experimental group				**Control group**		
Learners' Pseudonyms	***sex***	***Post-test scores***		***Learners' Pseudonyms***	***Sex***	***Post-test scores***
L1	F	29		L16	F	28
L2	F	20		L17	M	23
L3	M	22		L18	F	17
L4	M	19		L19	M	19
L5	M	21		L20	F	16
L6	M	13		L21	M	21
L7	M	19		L22	M	13
L8	F	25		L23	M	18
L9	F	21		L24	M	30
L10	M	26		L25	M	19
L11	M	24		L26	M	34
L12	F	20		L27	M	23
L13	F	28		L28	M	28
L14	M	25		L29	F	27

L15	M	29		L30	F	13
Mean score		**22.73**		**Mean score**		**21.93**

Table 4.4 shows the Experimental group and Control group post-test actual scores which are then translated into a bar chart below in Figure 4.2 to compare the two groups' post-test mean scores.

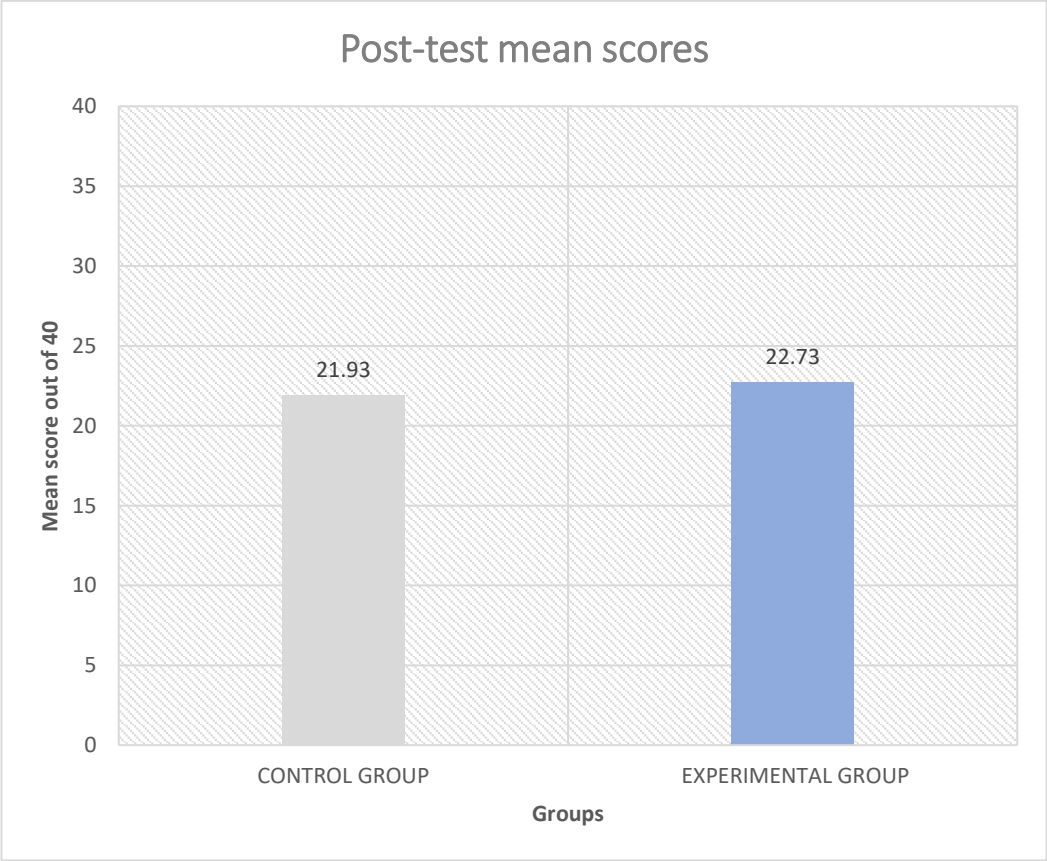


Figure 4.2. Comparison of the post-test scores

Figure 4.2 shows that the mean score of the Experimental group was slightly higher than the Control group's mean score with a difference of 0.8 scores. To determine whether this difference is statistically significant, an unpaired t-test is presented in Table 4.5 below, which tested the following hypotheses:

H_0: There is no statistically significant difference in the Biology Achievement test post-test scores of the Experimental group and Control group.

H_1: There is a statistically significant difference in the Biology Achievement test post-test of the Experimental group and Control group.

Table 4.5: Biology achievement test post-test statistics of the experimental and control groups

Summary of test statistics (post-tests)		
	Experimental	Control Group
Observations	15	15
Missing	0	0
Mean	22.73	21.93
Median	22	21
Mode	29	28
Range	16	21
Standard Deviation	4.42	6.35
Variance	19.50	40.35
T-value	0.69	
T-critical value	2.06	
Degree of Freedom (df)	25	

Table 4.5 above shows that at α =0.05 and *df* = 25, the t- calculated = 0.69 is lower than the t- critical =2.06. It can, therefore, be concluded that there was no statistically significant difference between the Biology Achievement post-test scores of the Experimental group and the Control group.

The next subsection presents the comparison of the Biology Achievement pre-test and post-test scores of the Experimental group and Control group.

4.4.4 Biology pre-test and post-test scores of the Experimental group and Control group

This subsection presents a comparison of Biology Achievement pre-test and post-test scores of the Experimental group and Control group. Figure 4.3 below shows the paired Biology achievement pre-test and post-test scores of the Experimental group.

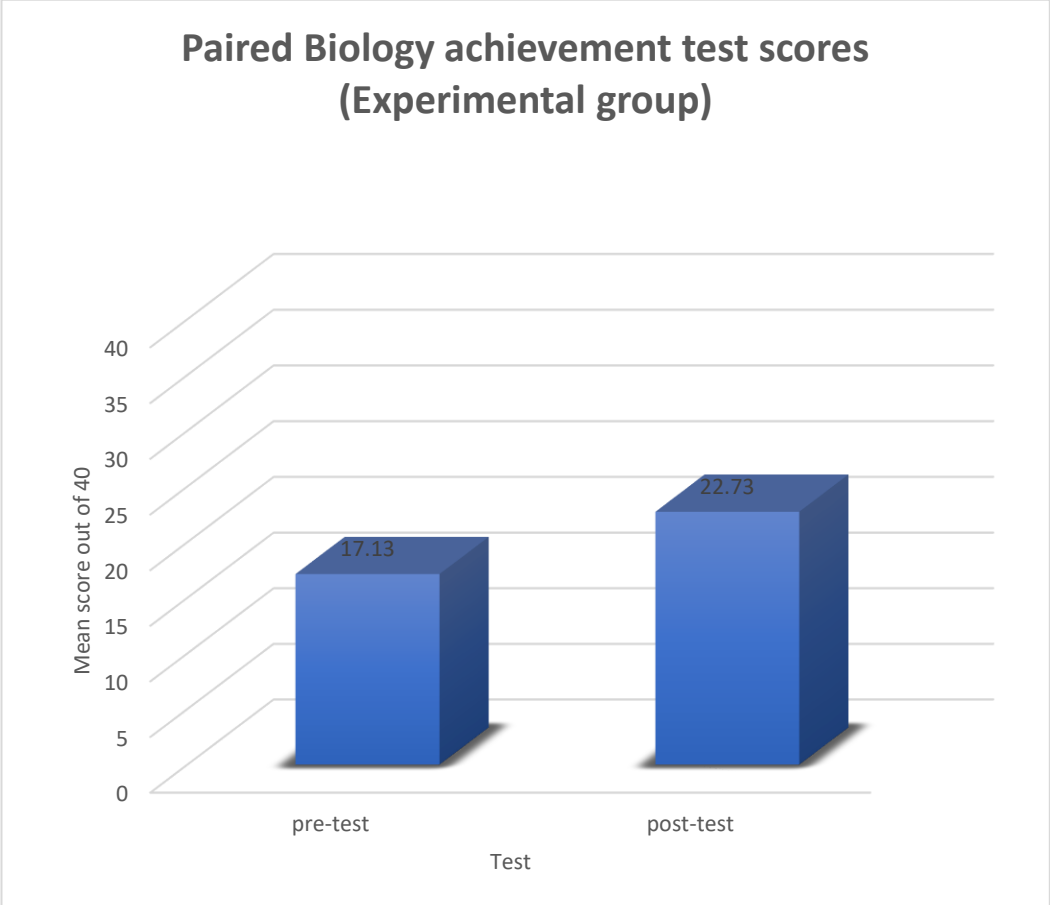


Figure 4.3. Comparison of paired Biology achievement test scores (experimental group)

Figure 4.3 shows that the post-test mean score was higher than the pre-test mean score with 5.6 mean scores. To determine whether this difference is statistically significant, a paired t-test is presented in Table 4.6, which tested the following hypotheses.

H_0: There is no statistically significant difference between the Biology Achievement pre-test and post-test mean scores of the Experimental group.

H_1: There is a statistically significant difference between the Biology Achievement pre-test and post-test mean scores of the Experimental group.

Table 4.6

Paired Biology achievement test statistics (experimental group)

Summary of the test statistics (experimental group)		
Mean	*Pre-test*	*Post-test*
	17.13	22.73
Variance	17.41	19.50
df	14	
P(T<=t) two-tail	8.99	
t Critical two-tail	2.14	

Table 4.6 above shows that at α = 0.05 and *df* = 14, the t- calculated = 8.99 is higher than the t- critical = 2.14. It can, therefore, be concluded that there was a statistically significant difference between the Biology Achievement test pre-test and post-test mean scores of the Experimental group.

The next subsection presents the comparison of the Biology Achievement pre-test and post-test mean scores of the Control group.

4.4.5 Biology achievement test pre-test and post-test mean scores of the control group

This subsection presents a comparison of the Biology Achievement pre-test and post-test of the Control group. Figure 4.4 below shows paired Biology achievement test pre-test and post-test scores of the Control group.

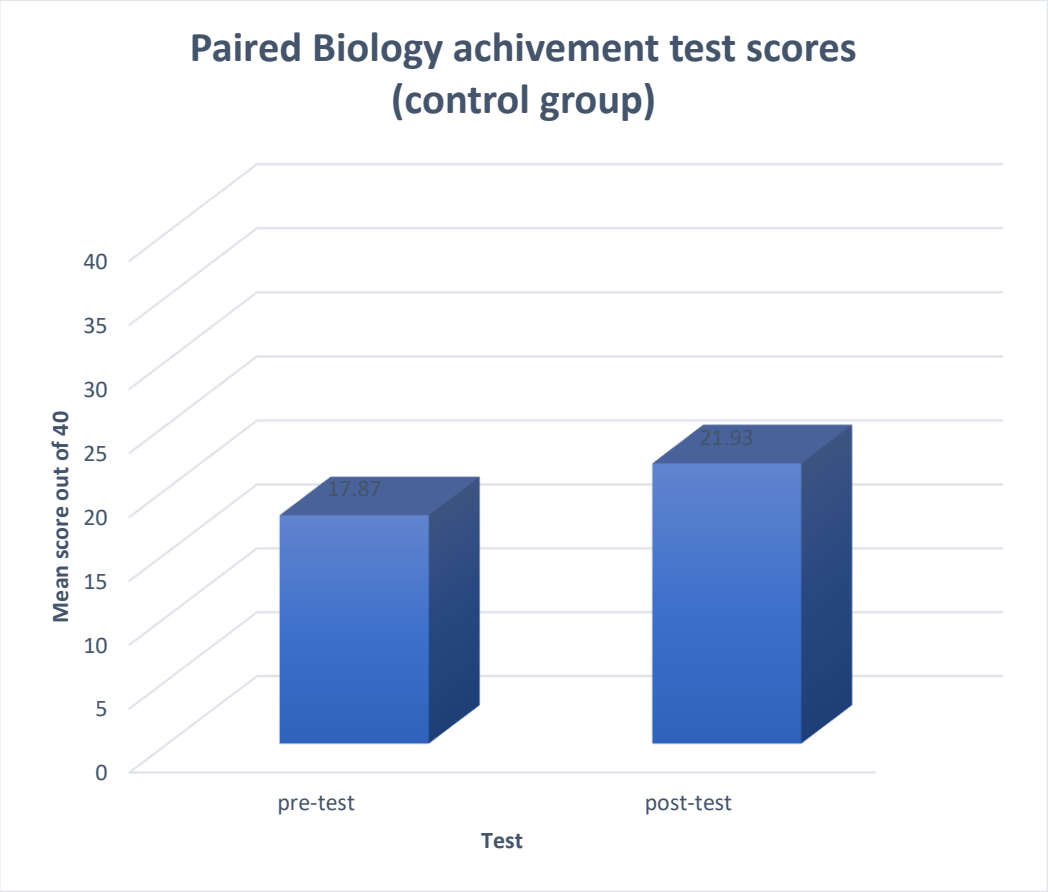


Figure 4.4. Comparison of paired Biology achievement test scores (control group)

Figure 4.4 above shows that the post-test mean score was higher than the pre-test mean score with a 4.06 mean score. To determine whether this difference was statistically

significant, a paired t-test is presented in Table 4.7 below, which tested the following hypotheses:

H_0: There is no statistically significant difference between the Biology Achievement pre-test and post-test scores of the Control group.

H_1: There is a statistically significant difference between the Biology Achievement Pre-test and post-test Control group.

Table 4.7.

Paired Biology achievement test statistics (experimental group)

Summary of the test statistics (control group)		
	Pre-test	*Post-test*
Mean	17.87	21.93
Variance	44.27	40.35
df	14	
P(T<=t) two-tail	0.0005	
t Critical two-tail	2.14	

Table 4.6 above shows that at α = 0.05 and *df* = 14, the t- calculated = 0.0005 is lower than the t- critical = 2.14. It can, therefore, be concluded that there was no statistically significant difference between the Biology Achievement test pre-test and post-test mean score of the Control group.

4.5 Presentation of qualitative data

This section presents the findings from the qualitative data. All ten Grade 11 learners who participated in focus group discussions were assigned pseudonyms (L2, L6, L8, L9, L10, L11, L12, L13, L14, L15). This was done to protect the identity of the

participants. The findings are presented thematically through four themes that emerged from the study. The themes were:

(1) Ability to see what is being taught.

(2) Provision of an opportunity for imagination and easy remembrance.

(3) The effect of using improvised instructional materials in understanding 'Gas exchange in humans' easily, and

(4) The shortcomings of using improvised instructional materials in Biology.

4.5.1 Ability to see what is being taught

During the focus group interview, the learners were asked to give their thoughts about being taught with improvised instructional materials. A learner (L2) from the first focus group discussions responded that "*it helps us to see things we are being taught with our own eyes"*. Similarly, another learner (L6) from the second focus group discussion mentioned that "*It is good, it makes lessons fun and gives us a sense of pride because sometimes we are learning with things we made ourselves"*. In addition, a learner (L12) from the first focus group discussion stated that "*I think it is more practical, so it is very informative as you can see the materials that are being taught, and sometimes it is us using the materials even'*. To emphasise, another learner (L8) from the second focus group discussion made a comparison that "*it is better than a teacher presenting the lesson without anything to demonstrate what he/she is teaching for us to see, theory alone without demonstrations is very boring sometimes"*.

4.5.2 Provision of an opportunity for imagination and easy remembrance

When learners were asked about what they liked most about being taught Biology with improvised instructional materials, a learner (L14) from the second focus group discussion responded that "*I like improvised instructional materials because, that*

pictorial print the materials leaves in your mind can really help a person to answer the questions, especially practical questions". In support, another learner (L2) from the first focus group discussion stated that "*I like being taught with improvised instructional materials because they make me comfortable, and they help me to imagine more about the topic we are being taught. Example, the topic of 'gas exchange in humans' that we just did"*. A learner (L9) from the second focus group discussion asserted that:

> "*because I was able to feel the materials, it really helped me to remember the content during the test, it was more like I could still see the demonstration moments that occurred during the lesson. Also, sometimes one does not even need to study that much at that area or topic anymore"*

Correspondingly, a learner (L8) from the second focus group discussions confirmed that "*what I like most is being able to touch and feel the materials. So, it helps me to recognize and remember the content. Also, it makes labelling and identifying of structures/parts on a diagram easy for me"*.

4.5.3 The effect of using improvised instructional materials in understanding 'Gas exchange in humans' easily

When learners were asked if improvised instructional materials helped them understand the topic of 'Gas exchange in humans', a learner (L10) from the first focus group discussions responded that:

> "*Of course, the materials made me to be more interested in the lesson, which then helped me to understand the content even faster, I even tried to make my own improvised instructional materials at home just to keep repeating what was demonstrated and to make sure I get every information"*.

It is evident from the learners' answers that they found improvised instructional materials effective since they could understand the content better. A learner (L13) from the first focus group discussions concurs that "*one gets to understand the topic better because the teacher is explaining and demonstrating at the same time, therefore when you do not understand what is being explained at time, I am sure the demonstration will help you understand better".* In the same vein, a learner (L2) from the first focus group discussion agreed and recommended that, "*teachers should continue or use more instructional materials in lessons because those materials can really help us learners to get better symbols at the end"*. Another learner (L15) from the first focus group discussions also insisted for the use of improvised instructional materials in Biology to happen more often by claiming that "*the model helped me to understand the topic of gas exchange in humans. I used to struggle with this topic since grade 8 but now I am comfortable with this topic, so I think these materials should be used more often"*.

During the interview, when learners were asked about the disadvantages of using improvised instructional materials in Biology, the following points were also raised. For example, a learner (L6) from the second focus group discussion noted that "*I think improvised instructional materials could be dangerous sometimes as well, based on the materials they are made from"*. Another learner (L10) from the first focus group discussions added that "*Sometimes the materials used to come up with the improvised instructional materials can be dangerous, more especially if a teacher does not have enough knowledge about them. Therefore, I think teachers need enough training just for safety purposes"*. A learner (L9) from the second focus group discussion reported that "*for me, it is time-consuming to use those. I think using these materials when one*

is not well prepared can waste time, and in the end, he/she might end up not presenting more of what they wanted to".

4.6 Summary of the findings

This chapter presented the findings of the study that investigated the effects of using improvised instructional materials on Grade 11 learners' achievement in Biology. Adopting a mixed-method approach, the data was collected from one selected secondary school in the Omuthiya circuit, Oshikoto region. The quantitative data analysis compared the test scores of the experimental group of 15 learners (who were taught using improvised instructional materials) with the 15 learners of the control group (who were taught using the usual traditional instructional materials, such as a textbook and teacher's notes). Although there were no statistically significant differences between the scores, it is worth pointing out that the Experimental group performed better than the Control group with a difference of 0.8 mean scores in the post-test. Furthermore, the comparison of the experimental group pre-test to the post-test showed a major difference of 5.6 mean score after the use of improvised instructional materials. The control group comparison of the pre-test to the post-test also showed an improvement of 4.06 after the use of usual traditional instructional materials.

Regarding the qualitative findings collected through focus group discussions, the participants praised the use of improvised instructional materials in the learning of Biology. These sentiments were demonstrated through three themes:

(1) Ability to see what is being taught.

(2) Provision of an opportunity for imagination and easy remembrance; and

(3) The effect of using improvised instructional materials in understanding 'gas exchange in humans' easily.

The findings from the qualitative data analysis also noted the disadvantages of using improvised instructional materials in Biology such as time-wasting, more specifically if there is no proper preparation, and set-up or lack of knowledge about the use of improvised instructional materials by the teacher. The potential danger associated with the use of improvised instructional materials was raised as one of the disadvantages. Therefore, precautions should be observed when handling them. The next chapter presents the discussion of the findings of the study.

CHAPTER 5: DISCUSSION OF THE FINDINGS

5.1 Introduction

The aim of this study was to investigate the effect of using improvised instructional materials on Grade 11 learners' achievement in Biology at a selected school in the Omuthiya circuit, Oshikoto region. Therefore, this chapter discusses the findings collected through a pre-test and post-test Biology Achievement Test and focus group discussions under the following themes:

1. The effect of improvised instructional materials on learners' achievement in Biology.
2. The Experimental group views on the effects of improvised instructional materials on learners' achievement in Biology on the topic of 'Gas exchange in humans.'

5.2 The effect of improvised instructional materials on learners' achievement in Biology

This sub-section presents the discussion of the findings that emerged from the Biology Achievement Test of the pre-test and post-test.

5.2.1 Biology achievement test scores unpaired comparison

The comparison of the mean scores of the Experimental group and Control group on the pre-test and post-test was done to determine learners' performance in both tests. Both groups were given the pre-test before the intervention and a post-test after the intervention. As presented in Figure 4.1, the pre-test findings showed that the Control group scored slightly higher than the Experimental group with a difference of 0.74 mean score. The findings are consistent with Uugwanga's (2020) study findings on the effects of authentic learning activities on achievements and attitudes towards natural

science among grade 7 learners in Khomas and Omusati educational region, in which the Experimental group and the Control group mean scores were almost the same. Similarly, Perez (2007), in a study that investigated the effectiveness of the learner–centred approach in teaching and learning acids and bases in two selected secondary schools in Ohangwena region, Namibia, found that there was no significant difference between pre-test results for both groups (Experimental and Control group).

These findings show that learners in both groups seemed to have begun the study with almost the same knowledge about the topic of 'Gas exchange in humans' before the intervention as shown in Figure 4.1. The slight difference observed could be due to prior knowledge that learners had in the topic of 'Gas exchange in humans'. According to Van Riesen et al. (2022), prior knowledge can have a significant effect on learners' learning and achievement in the subject. However, to find out if the observed slight difference was statistically significant or not, an unpaired t-test was carried out. A as presented in Table 4.3, the results shows that the t-calculated was lower (0.72) than the t-critical value (2.06), which indicate that there was no statistically significant difference between the two groups pre-test mean scores. Therefore, as far as the pre-test mean scores were concerned, the learners in both groups started the study with the same knowledge and understanding in the topic of 'Gas exchange in humans'. Similarly, as study by Nsa et al. (2013) on the instructional materials utilization and students' performance in practical agriculture found that the experimental group and the control group scored the same mean scores in a pre-test.

The post-test results, as presented in Figure 4.2, showed that the Experimental group scored slightly higher than the Control group with a difference of 0.8 mean scores. To investigate whether the observed difference was statistically significant or not, an unpaired t-test was carried out. The results of the t-test, as shown in Table 4.4, showed

that the t-calculated was lower than the t-critical value. This indicates that there was no statistically significant difference between the Experimental group and Control group Biology achievement post-test mean scores. The findings deemed to prove the null hypothesis correct, which states:

H_0 There is no statistically significant difference in the performance of the Grade 11 learners' achievement in Biology between those taught with improvised instructional materials and those taught using the usual traditional method.

The findings confirm previous research conclusions such as the study by Kambeyo and Ngcoza (2017) who found that improvised instructional materials results in a similar performance as the standard instructional materials. Therefore, this suggests that learners should be given opportunities to learn with what is available in their environmental setting rather than depending only on textbooks and other commonly used materials. Munir and Atiku (2018), however, in their study noted and argued that where there is no difference between the effect of improvised instructional materials and traditional instructional materials on learners' achievement, there is a need to establish a well-coordinated interaction between policymakers and facilitators for the provision of available materials that can be used for improvisation as funds for standard instructional materials might not be available.

Even though there was no statistically significant difference as shown in Table 4.4, it is worth pointing that the Experimental group performed better than the Control group with a difference of 0.8 mean scores in the post-test. The better performance of the Experimental group could be due to the use of instructional materials in the teaching of the topic 'Gas exchange in humans' to the learners. The Experimental group surpassing the control group in the post-test despite the fact that the Control group scored slightly higher than the Experimental group in the pre-test shows a possible

impact of using improvised instructional materials. The literature also supports that improvised instructional materials have a more positive significant difference on learners' academic achievement compared to standard instructional materials (Chukwunazo et al., 2022; Nwoke & Nwamen., 2016; Obodo et al., 2020).

5.2.2 Biology achievement test scores paired comparison

A comparison between the pre-test and post-test of the Experimental group in the Biology Achievement test mean scores showed that learners performed better in their post-test than the pre-test with a difference of 5.6 mean scores. A paired t-test conducted to test if the difference was statistically significant showed that the t-calculated was greater than the t-critical. Therefore, the difference between the pre-test and post-test of the Experimental group was statistically significant. The increased mean score achieved by learners in the Biology Achievement test between the pre-test and post-test could be attributed to the exposure of those learners to the improvised instructional materials that were used to deliver the lesson on the topic of 'Gas exchange in humans'. The results are similar to the results of Effiong and Igiri's (2015) study on the impact of instructional materials in teaching and learning of Biology in senior secondary schools in Yakurr LG A. Their study revealed that the comparison between learners' performance in the pre-test and post-test showed a huge increase in learners' performance after being taught using improvised instructional materials. Similarly, Mushimigimana et al. (2022), in a study about the impacts of improvised instructional materials on grade nine learners' performance in Chemistry, argued that improvised instructional materials increase learners' understanding of concepts, which in return leads to better academic achievement.

Another comparison made was of the pre-test and post-test mean scores of the Control group. As presented in Figure 4.4, the results showed that there was an increase in the

mean scores between the pre-test and post-test with 4.06 mean scores. The paired t-test that compared the two tests' scores showed that the t-calculated was lower than the t-critical; therefore, there was no statistically significant difference between the pre-test and post-test mean scores of the Control group in the Biology Achievement test. However, a difference of 4.06 that was observed between the two tests could be attributed to the learners' exposure to the learning content on the topic 'Gas exchange in humans', which was presented to them with the use of usual traditional instructional materials. These results agree with the findings of Uugwanga (2020) who, in the study about the effects of authentic learning activities on achievements and attitude towards natural science among grade seven (7) learners in the Khomas and Omusati educational regions, found that learners' performance in the test of two groups increased after the intervention.

The statistical analysis t-tests, which were carried out based on learners' mean score achievements in the Experimental group and Control group, showed that there was no significant difference between the two groups' mean score achievements as shown in Table 4.5. However, Figure 4.2 showed a mean score difference of 0.8 in favour of the experimental group. Therefore, that difference in mean score could have emerged due to improvised instructional materials that were used in the experimental group. Moreover, as shown in Table 4.6 and Table 4.7, improvised instructional materials have the same positive impact on learners' academic achievement in Biology as the usual traditional instructional materials.

5.3 The Experimental group's views on the effects of improvised instructional materials

Ten Grade 11 learners from the experimental group took part in focus group discussions which aimed to get their in-depth views about the effects of using

improvised instructional materials on their achievement in Biology. The emerging findings are discussed below.

5.3.1 Ability to see what is being taught

The results of this study revealed that learners applauded the use of improvised instructional materials in the learning of Biology, especially since these materials present them with an opportunity to see what they are being taught. The results further revealed that using improvised instructional materials tends to be very useful when it comes to practical questions which one can answer well with practical skills that could be best achieved through demonstrations rather than theory. Moreover, learners have observed that improvised instructional materials trigger a sense of pride and ownership in them because they are familiar with the materials used to come up with the improvised instructional materials. These findings are consistent with Ibe et al. (2021) whose study investigated the effect of improvised instructional materials on Chemistry students' academic retention in secondary schools and found that improvised instructional materials lead to a high retention rate of the subject content in learners; this is because it stimulates their brain and creates a feeling of practicality. Furthermore, Osei-himah et al. (2018) acknowledged that improvised instructional materials enhance learners' understanding in the subject during the process of teaching and learning.

5.3.2 Provision of opportunity for imagination and easy remembrance

The majority of the learners indicated that they appreciate being taught with improvised instructional materials. They further added that they prefer improvised instructional materials because, through touching and seeing, the materials help them to remember what was being taught.

The above-mentioned findings resonate with the finding of previous studies. That is, a Nigeria study by Obodo et al. (2020) found that learners taught with improvised instructional materials performed better than those taught without. In the same study, Obodo et al. (2020) further stated that the difference in achievement came because learners taught with improvised instructional materials are exposed to materials that are found in their daily world; therefore, they capture the learners' interest which then leads to maximum comprehension of the subject content. Similarly, Ajoke (2017) concluded that instructional materials make learning more fun and appealing, which then causes both teachers to be effectively involved in the lesson.

5.3.3 Possible negative effect of using improvised instructional materials in Biology

The study's findings revealed that some learners were concerned with their safety and that they could be at risk when improvised instructional materials are being used in class depending on the materials they are made from. The results showed that the learners (L6 from the second focus group discussion, L10 from the first focus group discussion, and L15 from the first focus group discussion) cautioned that teachers should always make sure that the materials used are not dangerous, and if they are, they should fully put into consideration the precautions that need to be taken to avoid injuries or harm. Similar concerns have been addressed in the literature. For example, Mensah (2015), whose study investigated the use of improvised instructional materials to teach chemical methods, urged that more teachers training on the setting up and use of improvised instructional materials is needed to ensure that the materials used are not endangering the learning environment. In addition, some learners further noted that the use of improvised instructional materials could be time-wasting, especially when the teacher is not well-prepared. In this regard, Obidike (2021) remarked that a teacher

needs to be fully prepared for the use of the chosen improvised instructional materials at least a day before the lesson; therefore, improvised instructional that are not available or not easy to set up shall not be included in the lesson plan.

5.3.4 Effects of using improvised instructional materials

The findings presented so far revealed that most learners responded positively that improvised instructional materials helped them grasp the content of 'Gas exchange in humans' easily. The learners further expressed that improvised instructional materials made the lesson fun and it stimulated their interest in the topic. Furthermore, most learners requested the use of improvised instructional materials in Biology to continue as it helps with understanding the content being taught and the stimulation of the brain, which will then help learners to retain the content. Audu (2020) support these findings that "improvisation of instructional materials provides direct experience with reality as well as encourage active participants and acquisition of skills especially where pupils are allowed to manipulate the materials" (p. 6).

One learner (L14) from the second focus group discussion suggested that more training should be given to teachers about improvised instructional materials so they can continue to use improvised instructional materials in Biology. These findings seem to support the recommendations made by Nnorom and Obianuju (2021) in their study about "improvisation in science instruction and the role of science teachers", they recommended that more seminars, workshops and bookshops on improvisation techniques need to be carried out to help teachers to improve and update their competence.

5.4 Triangulation of the findings

The two sets of data, one collected through the quantitative method and the other through the qualitative method, provided an opportunity for the comparison of results from different perspectives as well as to cross-validate the study results (Creswell, 2014). As presented in Table 4.4, the results from the Biology Achievement Test post-test (quantitative results) showed that there is no statistically significant difference between the experimental group's mean score and the control group's mean score. However, it is worth noting that the experimental group performed better than the control group with a mean score difference of 0.8 in the post-test. The better performance in the post-test by the experimental group could be attributed to the use of improvised instructional materials in the teaching of the topic 'Gas exchange in humans' to the learners. Although the two sets of data did not produce 100% similar results when compared, the findings from the focus group discussion (qualitative results) to a certain extent appeared to confirm the study's hypothesis that improvised instructional materials have a positive effect on learners. This is because improvised instructional materials make the content easy to understand while at the same time making the lesson fun for the learners. Furthermore, the study found that improvised instructional materials stimulate the leaners' brains into deep imaginations about the content, which therefore helps with easy remembrance. Therefore, the triangulations of the study's results from the quantitative approach and the qualitative approach were used to reach a general valid conclusion that the improvised instructional materials have a positive effect on the Grade 11 learner's achievement in Biology. Hence, the findings suggest that one source of data from either a quantitative approach or qualitative cannot be used to disprove where one source of data nullifies an assumption generated by another, they should complement each other.

5.5 Linking the Condition of Learning Theory to the findings

The Condition of Learning Theory states that:

> "There are different types of learning outcomes, each of which is best achieved through its specific instructional design, but also that there is a set of steps required every learning environment" (Gagne, 1965, as cited in Zimmerman & Schunk, 2002, p.28).

The researcher found this theory to be relevant in this study because it addresses the need for instructional materials for each specific activity in order to meet diverse learning styles and to ensure the lessons objectives are comprehensively attained by the learners. The results of this study are in accordance with the Condition of Learning Theory in the sense that although there was no statistically significant difference in learners' achievement between those taught with improvised instructional materials and those taught with usual traditional instructional materials, it was found that learners' achievement in the Biology achievement test improved after using different instructional materials, just like the theory urged about the use of "multiple discrimination which involves relating different responses to different stimuli" (Gagne,1974, p.18). Furthermore, the findings from the focus group discussion revealed that improvised instructional materials helped learners with their achievement in Biology by stimulating their brains and gaining their attention in order to grasp the content. This is similar to one of Gagne's nine events of instructions, which talks about "gaining attention" – using pictures and relevant scenarios (Gagne and Medsker, 1996 as cited in Ullah et al., 2015, p. 536)

5.6 Conclusions

This chapter presented and discussed the findings on the effect of improvised instructional materials on Grade 11 learners' academic achievement in Biology at a selected school in Omuthiya circuit. This study found that improvised instructional materials have the same effect on learners' academic achievement as the usual traditional instructional materials. Also, it was revealed that the use of improvised instructional materials in teaching of Biology had a positive effect on learners' academic achievement. In the next chapter, the summary of the research findings, conclusions, and recommendations are presented.

CHAPTER 6: SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

6.1 Introduction

This chapter presents a summary, conclusion, and recommendations based on the findings of the study. Possible areas for further research have also been identified in this chapter.

6.2 Summary

This study looked at the effects of using improvised instructional materials on Grade 11 learners' achievement in Biology at a selected school in Omuthiya circuit, Oshikoto region. As presented in Chapter 1, the study sought to answer the following questions and hypotheses:

Main question:

1. What are the effects of using improvised instructional materials on the Grade 11 learner's achievement in Biology at a selected school in Omuthiya circuit?

Sub-questions

1. How do improvised instructional materials contribute to learners' achievement in Biology?
2. What are the views of learners in the experimental group on the effect of using improvised instructional materials in the teaching and learning of Biology?

Hypotheses:

$\mathbf{H_0}$ There is no statistically significant difference in the performance of the Grade 11 learners' achievement in Biology between those taught with improvised instructional materials and those taught using the usual traditional method.

$\mathbf{H_1}$ There is a statistically significant difference in the performance of the Grade 11 learners' achievement in Biology between those taught with improvised instructional materials and those taught using the usual traditional method.

The study employed the mixed-method research approach and used the quasi-experimental design. The data were collected through a focus group discussion. The targeted population of this study consisted of all nine (9) secondary schools in Omuthiya circuit, with a population of about 758 learners. Purposive sampling was used to select one secondary school that offer Biology from the nine secondary schools in the circuit. The selected school had one Grade 11 class with thirty (30) learners doing Biology, which were then further randomly divided equally into two groups (Experimental group and Control group).

The researcher used a Biology Achievement Test (BAT) as a tool for collecting data whereby a pre-test and post-test was given to the Experimental group and Control group. In order to investigate the grade 11 learners' achievement scores in Biology in the topic of 'Gas exchange in humans', both the Experimental group and Control group were administered with the same pre-test before the intervention. The 15 learners in the Experimental group were taught Biology on the topic of 'Gas exchange in humans' for a period of six weeks, using improvised instructional materials (a breathing model and a box made structure of an alveolus) by the researcher. The other 15 learners in the Control group were taught with Biology in the same topic using the usual traditional instructional materials (textbook and chalkboard) by the researcher as well. Thereafter, the same Biology achievement test that was administered in the pre-test was administered again to the two groups as a post-test to determine the effect of improvised instructional materials on Grade 11 learners' achievement scores.

The results of the pre-test found that the Control group mean score was slightly higher than the Experimental group with 0.74 mean scores. This means that both learners in the two groups seemed to have started at the same level of knowledge and understanding in Biology in the topic of 'Gas exchange in humans' before the intervention was carried out. However, to be certain if the difference was statistically significant, an unpaired t-test was carried out which showed a t-calculated = 0.72 and t-critical = 2.06. Thus, it was concluded that there was no statistically significant difference between the Experimental group and Control group before the intervention.

The results of the post-test for the two groups revealed that the Experimental group scored slightly higher than the Control group with the mean score of 0.8. This difference emerged because of improvised instructional materials that was used during the intervention, especially that the Control group mean score achievement was slightly higher in the pre-test. However, to be certain if the difference was significant, a statistical unpaired t-test was carried out, which showed a t-calculated = 0.69 and a t-critical =2.06. Thus, it was concluded that there was no significant difference between the Experimental group and Control group after the intervention. The statistical results seem to concur with the findings of Kambeyo and Ngcoza (2017) who conclude that improvised instructional materials and usual traditional instructional materials yield same achievement in learners.

Nonetheless, the comparison of the Experimental group and Control group pre-test to the post-test showed an improvement in learners' achievement in both groups. The improved mean score achievements of the Experimental group from M =17.13 to M = 22.73 attributes to the use of improvised instructional materials. On the other hand, the Control group also changed from M = 17.87 to M = 21.93.

Through the focus group discussions, it was further found that the learners acknowledged the use of improvised instructional materials in Biology as they believed that it helped them to understand the content better than being taught without them. Furthermore, the learners appreciated the use of improvised instructional materials by commenting that improvise instructional materials help them imagine more about the topic under discussion. While the learners have noted how the improvised instructional materials make it easy to understand the content being taught, they also highlighted the shortcomings that are associated with improvised instructional materials. One of their primary concerns is that some materials that are used to set up the improvised instructional materials could be dangerous; therefore, the learners suggested for teachers to be given trainings on how to deal with improvised instructional materials. Furthermore, it was revealed that improvised instructional materials help learners to retain memory by stimulating their brain, since learners are familiar with the materials used as many can be from their environment.

6.3 Conclusion

This study investigated the effects of improvised instructional materials on Grade 11 learners' achievement in Biology at a selected school in the Omuthiya circuit, Oshikoto region. The study's quantitative findings showed an Experimental group mean score of 17.3 and 17.87 for the control group in their pre-test. The post-test revealed the mean score of 22.73 and 21.93 for the Experimental group and Control group respectively which then showed a slight difference of 0.8 in the post-test in favour of the Experimental group. However, an unpaired t-test showed that with an $\alpha = 0.05$ and $df = 25$, the statistical t-test revealed a t-calculated = 0.69 and t-critical = 2.06. The t-critical in this case was slightly higher than the t-calculated.

Therefore, the findings failed to reject the null hypothesis (H_0) which stated that:

H_0 There is no statistically significant difference in the performance of the Grade 11 learners' achievement in Biology between those taught with improvised instructional materials and those taught using the usual traditional method.

However, it is worth pointing out that the difference of 0.8 in the post-test mean scores between the experimental group and control group, as shown in Table 4.4, could be due to the use of improvised instructional materials in the teaching of learners. Furthermore, the comparison of the pre-test and post-test scores of the Experimental group and Control group showed the learners' improvement in their academic achievement in both two groups. The improvement observed after the intervention between the tests of both two groups show that, improvised instructional materials and usual traditional instructional materials had a positive effect on the learners' achievement in Biology. It can, therefore, be concluded that the use of improvised instructional materials in schools need to be encouraged as they seem to help learners with understanding the concepts which then lead to improved academic achievement.

The qualitative findings reveal that improvised instructional materials help learners to understand the subject content easily. It also helps learners with easily remembrance of what they were taught. Further, it was also revealed that improvised instructional materials stimulate the learners' brains which then help them to imagine more about the topic that is under discussion. Therefore, it can be concluded that the use of improvised instructional materials in Biology has a positive effect on learners' achievement. Although the quantitative and qualitative findings are not fully in agreement, after the triangulation of the results, the study concluded that improvised instructional materials have a positive effect on Grade 11 learners' achievement in Biology at a selected school in Omuthiya circuit, Oshikoto Region.

6.4 Recommendations

Based on the findings of the study, the following recommendations are made:

6.4.1 Recommendation for the Ministry of Education, Arts and Culture

- Improvised instructional materials and usual traditional instructional materials were found to have the same effect on learners' achievement. Therefore, the officials in the Ministry of Education, Arts and Culture should encourage the integration of both instructional materials in their Biology Lessons during teachers' trainings.
- Since the usual traditional instructional materials and improvised, instructional materials were found to have the same effect on learners' achievement, the Ministry of Education Arts and Culture needs to invest more in procuring the usual traditional instructional materials, as well as acquiring and supplying raw materials that teachers can possibly use at schools to make improvised instructional materials.

6.4.2 Recommendation for the Senior Education Officers of Biology

- The Biology Senior Education Officers should facilitate workshops to train teachers on the needed skills on setting up improvised instructional materials and consideration that teachers need to be aware of when dealing with them.

6.4.3 Recommendations for Biology teachers

- Biology teachers should incorporate the use of improvised instructional materials and usual traditional instructional materials in their lesson presentations as they both improve learners' academic achievement.
- Biology teachers are encouraged to seek and attend more workshops on improvisation to sharpen their skills and knowledge on how to come up with

improvised instructional materials and how to assemble and use all instructional materials.

6.4.4 Recommendations for future research

- This study was limited to one selected secondary school in one educational region; hence, the study recommends another study to be conducted with a larger sample in different educational regions and schools.
- More studies need to be carried out on the importance of using improvised instructional materials in the teaching and learning process in different Science subjects such as Chemistry and Physics.
- There is a need to investigate the teachers' experiences on the improvised instructional materials, after they have been introduced to the and tried them in their lessons.

REFERENCES

Adak, S. (2017). Effectiveness of constructivits approach on academic achievemet in science at secondary level. *Educational research rewiew, 12*(4), 1074-1079.

Ahmed, A. M. (2008). Improvisation of instructional materials for the teaching of Biology, an important innovation in the Nigerian educational system. *Pristine Journal*, 1-7.

Aina, J. K., & Olanipekun, S. (2015). A review of teachers' qualifications and its implication on students' academic achievement in Nigerian schools. *International Journal of Educational Research and Information Science, 2*(2), 10-15.

Aina, K. J. (2013). Instructional materials and improvisation in physics class: Implications for teaching and learning, Computer. *2*(20), 8.

Ajoke, A. R. (2017). The importance of instructional materials in teaching English as a second language. *International Journal of Humanities and Social Science Invention, 6*(9), 36-44.

Alamer, A., & Lee, J. (2019). A motivational process model explaining L2 Saudi students' achievement of English. *System*, 87.

Alharahsheh, H. H., & Pius, A. (2020). A review of key paradigms: Positivism VS interpretivism. *Global academic journal of humanities and social sciences, 2*(3), 39-43.

Amadioha, S. W. (2009). The importance of instructional materials in our schools an overview. *New Era Research Journal of Human, Educational and Sustainable Development, 2*(3), 4-9.

Amos, S., Eghan, M. P. K., & Oppong, E. (2022). The Impact of Instructional Materials in Teaching and Learning of Biology in the Colleges of Education in the Central Region of Ghana. *Open Journal of Educational Research*, 213-221.

Ashaver, D., & Igyuve, S. M. (2013). The use of audio-visual materials in the teaching and learning processes in colleges of education in Benue State-Nigeria. *IOSR Journal of Research & Method in Education, 1*(6), 44-55.

Audu, H. D. (2020). Effect of improvisation of instructional materials on attitude and academic performance of nomadic pupils in social studies in nomadic primary schools in north eastern states of Nigeria.

Ayua, G. A. (2011). Teachers' awareness and level of improvisation of primary science instructional materials in primary schools in Makurdi metropolis. *Benue State University Journal of Education*(11), 44-50.

Baidawi, A. (2016). Using visual media in teaching speaking. OKARA. *Jurnal Bahasa dan Sastra, 10*(1), 54-65.

Bailey. (2008). First steps in qualitative data analysis: transcribing. *Family practice, 25*(2), 127-131.

Bomide, G. (2007). Science Teaching in a period of recession: The need for improvisation. *Journals of Science Education of Nageria, 23*(2), 152-165.

Bremner, N. (2021). What is learner-centered education? A quantitative study of English language teachers' perspectives. *Tesl-Ej, 25*(2).

Bulusan, F. (2019). Selecting potential instructional materials for literature teaching in the 21st century millieu: Findings from a systematic review of literature. *Asian EFL journal, 21*(2), 218-21.

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., & Landes, N. (2006). *The BSCS 5E instructional model: Origins and effectiveness.* Colorado Springs, Co: BSCS.

Chinna, N. (2010). Effects of improvised instructional media on Niger states school students' achievement in Biology concepts. [Masters' thesis, Federal University of Technology, Minna Institutional Repository]. *Dspace*. Retrieved from https://repository.futminna.edu.ng:8080/jspui/handle/12346789/1423

Cooperman, L. (2007). Instructional design for online course development. *Journal of Veterinary Medical Education, 34*(3), 238-242.

Creswell, J. (2014). *Research Design: Qualitative, Quantitave and Mixed method approaches.* Califonia, USA: SAGE publications.

Dong, N., & Maynard, R. (2013). PowerUp!: A tool for calculating minimum detectable effect sizes and minimum required sample sizes for experimental and quasi-experimental design studies. *Journal of Research on Educational Effectiveness, 6*(1), 24-67.

Dooly, M., Moore, E., & Vallejo, C. (2017). *Research ethics.* Research-publishing.

Effiong, O. E., & Igiri, C. E. (2015). Impact of instructional materials in teaching and learning of biology in senior secondary schools in Yakurr LG A. *International letters of Social and humanistic sciences*, 27-33.

Ehiane, O. S. (2014). Discipline and academic performance (A study of selected secondary schools in Lagos, Nigeria). *International journal of academic research in progressive education and development, 3*(1), 181-194.

Enenya, P.R., & Muhammad, S.L. (2018). Biology teachers' attitude towards invention of instructional materials in Sebon-tasha inspectorial division. *Journals of science, technology & education, 6*(1). Retrieved from http://www.atbuftejoste.com

Fortsch, S., Fortsch, C., Von Kotzebue, L., & Neuhaus, B.J. (2018). Effects of teachers' professional knowledge and their use of three-dimensional physical model in Biology lessons on students' achievement. *Eduactional science, 8*(3), 118.

Fuady, R., & Mutalib, A. A. (2018). Audio-visual media in learning. *Journal of K6 Education and Management, 1*(2), 1-6.

Gwambombo, I. (2013). *The effect of teachers' workload on students' academic performance in community secondary schools: A study of Mbeya City (Doctoral dissertation, The Open University of Tanzania).*

Hamunyela, H. N., Makaye, J., & Cruz, K. C. D. (2022). Implementation of the Revised Biology Curriculum in Selected Junior Secondary Schools in Namibia. *Creative Education, 13*(9), 2958-2972.

Hasan, N., Rana, R. U., Chowdhury, S., Dola, A. J., & Rony, M. K. K. (2021). Ethical considerations in research. *Journal of Nursing Research, Patient Safety and Practise (JNRPSP)*, 1-4.

Ibe, N., Maxwell, O., & Chikendu, R. (2021). Effect of improvised instructional materials on Chemistry students' academic retention in secondary schools. *1*(5). doi:www. doi. org

Ibrahim, N., Mohammed, A.A., Abdullahi, M., Uzoma, G.I., & Bizi, M.G. (2021). The attitude of biology teachers towards improvisation and utilization of

intructional materials in teaching and learning of biology in private secondary schools in Potiskum local government area. *Journals homapage*. doi:10.30574

Ibrahim, S.A., Ibrahim, A., Ya'u, S., & Abdullah, S.A. (2019). Improvisation in teaching and learning biology in senior secondary schools: Prospects and challenges. *International journals of scientific research in multidisciplinary studies, 5*(11), 33-39.

Igiri, C. E., & Effiong, O. E. (2015). Impact of instructional materials in teaching and learning of biology in senior secondary schools in Yakurr LG A. *International Letters of Social and Humanistic Sciences*, 27-33.

Iji, C., Ogbole, P., Uka, N. (2014). Effect of improvised instructional materials on the students achievement in Geometry at the upper Basic education level in Makurdi Metropolis Benue state, Nigeria. *American journal of education research, 7*(2), 70-72. doi:10.12691/education-2-7-17.

In, J. (2017). Introduction of a pilot study. *Korean journal of anesthesiology, 70*(6), 601-605.

Juned, A.M., Majid, F.B., & Mustafa, S.M. (2020). Performance approach, Mastery approach, Performance avoidance and Mastery avoidance as predictors of student's academic achievement in English, Mathematics and Science subjects. *The international journals of academic research in business and social science*, 1150-1159.

Kallio, H., Pietilä, A. M., Johnson, M., & Kangasniemi, M. (2016). Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of advanced nursing, 72*(12), 2954-2965.

Kambeyo, L., & Ngcoza, K. M. (2017). Using Easily Accessible Resources to Teach Acids and Bases: A Namibian Case Study. *International Journal of Educational Sciences, 18*(1-3), 47-55.

Ketefian, S. (2015). Ethical considerations in research. Focus on vulnerable groups. *Investigación y Educación en Enfermería, 33*(1), 164-172.

Kibble, J. D. (2017). Best practices in summative assessment. Advances in physiology education. *41*(1), 110-119.

Kimani, G. N., Kara, A. M., & Njagi, L. W. (2013). *TEACHER FACTORS INFLUENCING STUDENTS'ACADEMIC ACHIEVEMENT IN SECONDARY SCHOOLS IN NYANDARUA COUNTY.* KENYA.

Kivunja, C., & Kuyini, A. B. (2017). Understanding and applying research paradigms in educational contexts. *International Journal of higher education, 6*(5), 26-41.

Kpolovie, P. J., Joe, A. I., & Okoto, T. (2014). Academic achievement prediction: Role of interest in learning and attitude towards school. *International Journal of Humanities Social Sciences and Education (IJHSSE), 1*(11), 73-100.

Kruse, K. (2009). Gagne's nine events of instruction: An introduction. *Retrieved the*, 10.

Leighton, J., & Gierl, M. (Eds.). (2007). *Cognitive diagnostic assessment for education: Theory and applications.* Cambridge University Press.

Lowe, N. K. (2019). What is a pilot study? *Journal of Obstetric, Gynecologic & Neonatal Nursing, 48*(2), 117-118.

Mauliya, I., Relianisa, R. Z., & Rokhyati, U. (2020). Lack of motivation factors creating poor academic performance in the context of graduate English department students. *Journal Of Linguistics and Language Teaching, 6*(2), 73-85.

Mayr, E. (2004). *What makes biology unique?: considerations on the autonomy of a scientific discipline.* Cambridge University Press.

Mboto, F. A., Ndem, N. U., & Stephen, U. (2011). Effects of improvised materials on students' achievement and retention of the concept of radioactivity. *African Research Review, 5*(1).

Mensah, D. (2015). Using improvised instructional materials to teach chemical methods. *Education and Psychology Department.*

Ministry of Education Arts and Culture, MoEAC. (2018b). Biology syllabus ordinary level: grade 10-11. *NIED*. doi:99916-69-12-4

Ministry of Education, Arts and Culture [MoEAC]. (2019c). *National Policy Guide for Natural Sciences.* Okahandja: NIED.

Ministry of Education, Arts and Culture, MoAEC. (2016a). *The national curriculum for basic education.* Okahandja: NIED.

Munir, A., & Atiku, F. (2018). Comparative effects of improvised and standard instructional materials on secondary students'academic performance in Physics. *Delivering Science, Technology & Mathematics Education in a Depressed Economy.* Kano State.

Muyoyeta, N. K. (2018). *Factors affecting Grade 12 learners' academic performance in the Namibia Senior Secondary Certificate ordinary level Biology in the*

Khomas educational region, Namibia (Doctoral dissertation, University of Namibia).

Nampa. (2024, May 28). Omuthiya's Lackhustre Perfomance Worries Director. *New Era Namibia*, p. 2. Retrieved from https://neweralive.na/omuthiyas-lacklustre-performance-worries-director

National Research Council, NRC. (2009). *The Role of Theory in Advancing 21st-Century Biology:Catalyzing Transformative Research.* Washington, DC: National Academies Press.

Ndjangala, M. N. N., Abah, J., & Mashebe, P. (2021). Teachers' Views on Challenges Affecting Learners' Performance in Natural Science. *International Journal of Evaluation and Research in Education, 10*(1), 48-56.

Neshila, K. F. (2018). *Academic resilience in Mathematics amongst at-risk Grade 10 learners in Namibia: A phenomenology study (Doctoral dissertation, University of Namibia).*

Nghishongwa, F. (2017). Challenges faced by senior secondary schools learners when preparing science fair projects in the Omusati educational region, Namibia [Master's thesis, University of Namibia]. *espace*.

Njoroge, P. M., & Nyabuto, A. N. (2014). Discipline as a factor in academic performance in Kenya. *Journal of Educational and Social Research, 4*(1), 289.

Nnorom, N., & Obianuju, C. M. (2021). Improvisation in science instruction and the roles of science teachers: an educational innovations for sustainable developments. *COOU Journal of Educational Research, 6*(1).

Nsa, S. O., Ikot, A. S., & Udo, M. F. (2013). Instructional materials utilization and students' performance in practical agriculture. *Journal of Educational Research and Reviews, 1*(4), 49-54.

Nwike, M. C., & Catherine, O. (2013). Effects of use of instructional materials on students cognitive achievement in agricultural science. *Journal of Educational and Social Research, 3*(5), 103.

Nwoke, B. I., & Nwaneri, O. M. (2016). Effect of Improvised Instructional Materials on Senior Secondary School Students Achievement and Retention in Mathematics. *International Technology Research Journal, 4*(1).

Obi, N.C., & Obi, J.J. (2019). Effect of improvised instructional materials on academic achivement of SSI Chemistry students in Cross River State, Nigeria. *International journal of Applied research, 5*(7), 444-448. Retrieved from www.allresearchjournal.com

Obidike, I. V. (2021). Production and improvisation of instructional materials for effective teaching and learning in early childhood care and education in Nigeria. *Sapientia Foundation Journal of Education, Sciences and Gender Studies, 3*(2).

Obodo, A. C., Ani, M. I., & Thompson, M. (2020). Effects of Improvised Teaching-Learning Materials on the Academic Performance of Junior Secondary School Students in Basic Science in Enugu State. *IOSR J. Res. Method Educ, 10*(4), 23-30.

Obodo, A. C., Ani, M. I., & Thompson, M. (2020). Effects of Improvised Teaching-Learning Materials on the Academic Performance of Junior Secondary School

Students in Basic Science in Enugu State, Nigeria. *IOSR J. Res. Method Educ, 10*(4), 20-23.

Ofori, K. N., Tordzro, G., Asamoah, E., & Achiaa, E. (2018). The effects of indiscipline on academic performance of junior high school students in the Fanteakwa District of Ghana. *JEP, 9*(21).

Ojelade, I. A., Aregbesola, B. G., Ekele, A., & Olatunde-Aiyedun, T. G. (2020). Effects of Audio-Visual Instructional Materials on Teaching Science Concepts in Secondary Schools in Bwari Area Council Abuja, Nigeria. Ojelade, IA, Aregbesola, BG, Ekele, A., & Aiyedun, TG (September 2020). Effects of Audio-Visual Instructional Materials. *The Environmental Studies Journal (TESJ), 3*(2), 52-61.

Okeke, C. (2019). Enriching benefit of improvisation of instructional materials for biology teachers and students. *International journal of advanced and educational research, 15*(4), 1-5. Retrieved from www.archjournals.org

Oladejo, M. A., Olosunde, G. R., Ojebisi, A. O., & Isola, O. M. (2011). Instructional materials and students' academic achievement in physics: some policyimplications. *European Journal of Humanities and social sciences, 2*(1).

Olawale, S. K. (2013). The use of instructional materials for effective learning of Islamic studies. *Jihat ul Islam, 6*(2), 20-30.

Omosewo, E. (2011). Effect of improvised and standard instructional materials on secondary school students' academic perfomance in Physics in IIorin, Nigeria. *Singapore journal of scientific reaserch., 1*(1), 68-76.

Osanloo, A., & Grant, C. (2016). Understanding, selecting, and integrating a theoretical framework in dissertation research: Creating the blueprint for your "house". *Administrative issues journal: connecting education, practice, and research, 4*(2).

Osei-Himah, V., Parker, J., & Asare, I. (2018). The effects of improvised materials on the study of science in basic schools in Aowin Municipality-Ghana. *Research on humanities and social sciences, 8*, 20-23.

Perez, A. (2007). Investigating the effectiveness of learner-centred approach in teaching and learning acids and bases in two selected secondary schools in Ohangwena region, Namibia. *BMC Public Health, 5*(1), 1-8.

Popova, A., Kirschner, P. A., & Joiner, R. (2014). Effects of primer podcasts on stimulating learning from lectures: How do students engage? *British Journal of Educational Technology, 42*(2), 330-339.

Rahi, S. (2017). Research design and methods: A systematic review of research paradigms, sampling issues and instruments development. *International Journal of Economics & Management Sciences, 6*(2), 1-5.

Richey, R. C. (2000). The Legacy of Robert M. Gagne. *ERIC Clearinghouse on Information & Technology, Syracuse University, 621 Skytop Rd., Suite 160, Syracuse, NY*, 13244-5290.

Ruslin, R., Mashuri, S., Rasak, M. S. A., Alhabsyi, F., & Syam, H. (2022). Semi-structured Interview: A methodological reflection on the development of a qualitative research instrument in educational studies. *IOSR Journal of Research & Method in Education (IOSR-JRME), 12*(1), 22-29.

Sale, M. (2016). The race of instructional materials in quality teaching at primary schools levels in Katsina Metropolis, Katsima state. *International journal of humanities and management sciences, 4*(2), 2320-4044.

Siachifuwe, M. (2017). Teacher based factors influencing academic performance among learners in open learning classes at Twin Palm Secondary School. *International Journal of Humanities Social Sciences and Education (IJHSSE), 4*(12), 96-101.

Singh, K. (2011). Study of achievement motivation in relation to academic achievement of students. *International Journal of Educational Planning & Administration, 1*(2), 161-171.

Steinmayr, R., Meiṅer, A., Weideinger, A. F., & Wirthwein, L. (2014). *Academic achievement (pp. 9780199756810-0108).* Oxford, Uk: Oxford University Press.

Taherdoost, H. (2022). What are different research approaches? Comprehensive Review of Qualitative, quantitative, and mixed method research, their applications, types, and limitations. *Journal of Management Science & Engineering Research, 5*(1), 53-63.

Thyer, B. A. (2012). *Quasi-experimental research designs.* Oxford University Press.

Tus, J., Lubo, R., Rayo, F., & Cruz, M. A. (2020). The learners'study habits and its relation on their academic performance. *International Journal Of All Research Writings, 2*(6), 1-19.

Twitchell, D., Gagne, R. M., & Merrill, M. D. (1990). Robert M. Gagne and M. David Merrill: In Conversation. *Educational Technology, 30*(12), 35-46. Retrieved from http://www.jstor.org/stable/44425547

Ullah, H., Rehman, A., & Bibi, S. (2015). Gagné's 9 events of instruction - a time tested way to improve teaching. *Pakistan Armed Forces Medical Journal, 65*(4), 535-539. Retrieved from https://www.pafmj.org/index.php/PAFMJ/article/view/1009

Uugwanga, J. S. (2020). The effects of authentic learning activities on achievements and attitude towards Natural Science among Grade 7 learners in Khomas and Omusati educational regions (Doctoral dissertation, University of Namibia).

van Riesen, S. A., Gijlers, H., Anjewierden, A. A., & de Jong, T. (2022). The influence of prior knowledge on the effectiveness of guided experiment design. *Interactive Learning Environments, 30*(1), 17-33.

Verner, V.N., Kandjeo-Marenga, H.U., Abah, J. & Mashebe, P. (2022). Challenges affecting grade 12 learners performance in O'level biology in //Kharas region, Namibia. *Open journal of social sciences, 10*(4). doi:10.4236/jss.2022.104005

Wiesnerová, D., & Vojtková, M. N. (2012). *Benefits of self-assessment in english classes at elementary schools (Bachelor Thesis).*

Zimmerman, B.J., & Schun, D.H. (Eds.). . (2002). *Educational Psychology: A Century of contributions: A project of Division 15 (Educational Psychology)of the American Psychology Society (1st ed).* Routlendge.

APPENDICES

APPENDIX A: BIOLOGY ACHIEVEMENT TEST

Biology Achievement Test on the Human Breathing System

Grade: 11 **Time: 60 minutes**

Instructions to Candidate

- This test consists of Sections A and B.
- Answer all the questions.
- Marks are allocated at the end of each question.
- Write clearly and legibly.

Candidate No……**Gender** ……

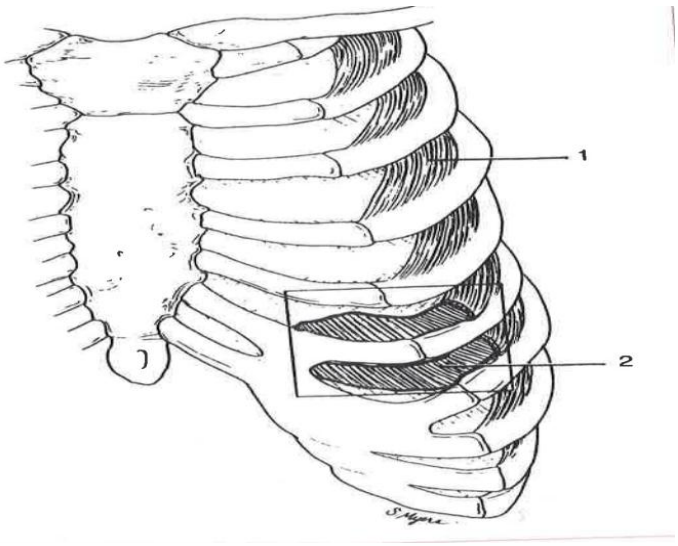
Age category (*mark with a cross at your appropriate age category*)

[15-16……] [17-18……] [19-20……] [20-21……]

Section A: multiple choice *(Choose the correct answer from the following questions about the Respiratory system by circling the letter next to the answer).*

1. Which of the following best describes breathing in Humans?
   A. The breathing in and out of oxygen and carbon dioxide
   B. The breathing in of oxygen.
   C. The inhalation and exhalation of carbon dioxide.
   D. The process of breathing in carbon dioxide and oxygen.

2. Study the diagram below and answer the questions that follow.



Number 2 on the diagram represents.

A. External intercostal muscle
B. Innermost muscle
C. Internal intercostal muscle
D. Outermost muscle

3. What is the purpose of cilia inside the nose?
   A. To fight diseases
   B. They serve no purpose.
   C. They sweep out mucus with dust and pathogens.
   D. To tickle the nose and cause sneezes.

4. What is the pathway that air takes from the atmosphere to the gas exchange surface in the lungs?
   A. Mouth →larynx →bronchus →bronchioles →alveolus
   B. Mouth →nose → trachea →bronchus →alveoli →bronchiole
   C. Nose →larynx →trachea →bronchus →bronchiole →alveolus
   D. Nose →trachea →bronchus →bronchiole →alveolus

5. Which one of the following best describes the function of the nasal cavity?
   A. It closes the oesophagus.
   B. It has a large surface area for gaseous exchange.
   C. It is where gaseous exchange takes place.
   D. It warms, cleans and moistens the inhaled air.

6. What happens to the chest during exhalation?
   A. Intercostal muscle contract
   B. The chest moves inward.
   C. The chest moves inward and outward at the same time.
   D. The chest moves upward and downward.

7. Which one is the feature of gaseous exchange?
   A. Thick-walled, large surface area, many capillaries
   B. Thick-walled, small surface area, few capillaries
   C. Thin-walled, large surface area, many capillaries.
   D. Thin-walled, small surface area, few capillaries.

8. Which one best describes the differences between breathing, respiration, and gaseous exchange?

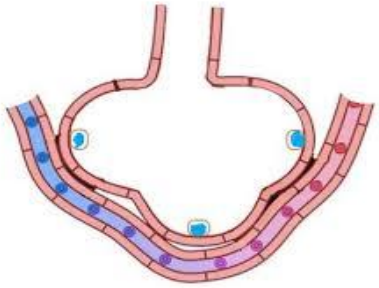
	Breathing	**Respiration**	**Gaseous exchange**
A	Breathing involves the lungs, muscles, and air passage.	Respiration occurs in the mitochondria in the cells.	Gaseous exchange involves the alveoli and capillaries.
B	A mechanism applied to transport oxygen.	Breaking down food to release energy.	The breaking down of the composition of air.
C	Increase in size of the lungs.	The product is glucose.	It happens in the lungs.
D	The removal of carbon dioxide.	A process of making own food.	The absorption of oxygen in the blood.

9. The diaphragm and the intercostal muscles work together during expiration at the end of strenuous exercise. Which of the following demonstrates what happens to the diaphragm and intercostal muscle during expiration?

	Diaphragm		**Intercostal muscle**	
			Internal	**External**
A	Contract	Moves down	Relax	Contract
B	Contract	Moves up	Relax	Contract
C	Relaxes	Moves down	Contract	Relax
D	Relaxes	Moves up	Contract	Relax

10. Which one is the function of cartilage in the trachea?
    A. Cleans the air as it moves to the lungs.
    B. Contracts to move the air into the lungs.
    C. Increase resistance to following into the lungs.
    D. Prevent the trachea from collapsing.

11. The photograph below shows a cell from the gas exchange system. What is this called?



A. Alveolar cell
B. Ciliated cell
C. Goblet cell
D. Muscle cell

12. The table below shows different gasses that human beings inspire. Which one illustrate the appropriate composition of inspired air?

Air inspired in percentages (%)				
	Nitrogen	**Oxygen**	**Carbon dioxide**	**Temperature**
A	78	78	21	Warmer
B	21	78	78	Warmer
C	78	21	4	Warmer
D	78	21	0.04	variable

13. Which process is involved in gaseous exchange in the human being?
    A. Active transport
    B. Diffusion
    C. Osmosis
    D. Photosynthesis

14. The exchange of oxygen and carbon dioxide between the blood capillaries and alveoli is mainly caused by?
    A. A layer of moisture in the lining of the capillaries
    B. It is due to the concentration gradient between the blood capillaries and the alveoli.
    C. Occurs due to warm air that rises from the trachea.
    D. Pressure caused by inhalation and exhalation.

15. How can one test the presence of carbon dioxide from the exhaled air?
    A. By bubbling carbon dioxide through clear lime water, lime water turns milky.
    B. By mixing carbon dioxide with hydrogen carbonate

C. Test with the Benedict's solution
D. The use of a litmus paper, that will turn red with presence of carbon dioxide.

16. Pete exercised for 20 minutes, for that duration his depth of breathing was 30 times per minute, 12 times more than when he was resting. Which of the following explains why?
    A. An increase in breathing depth for more oxygen supply, faster respiration rate, more energy released in the muscles and faster removal of carbon dioxide.
    B. An increase of energy supply to muscles, removal of lactic acid and cooling down the body.
    C. For faster removal of metabolic wastes
    D. To provide a large surface area for oxygen in the lungs

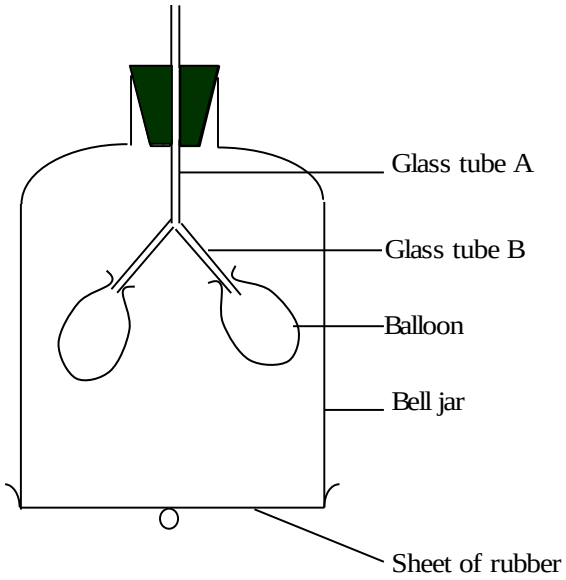
17. Which one is the effect of tar on the lungs?
    A. It causes the lungs to shrink.
    B. It fills up the lungs with water.
    C. It is addictive.
    D. Tar contain cancer-causing chemicals.

18. Which one of the following explains the danger of carbon monoxide from cigarettes to the human's breathing system?
    A. It combines with haemoglobins to form oxyhaemoglobin which takes up space for the oxygen needed to be transported.
    B. It combines with oxygen to form carbon dioxide.
    C. It irritates and that reads to lung failure.
    D. It leads to heart failure and death.

19. The term **COPD** refers to?
    A. Chronic Obstructive Pulmonary Disease
    B. Clinical Observation of Pulmonary Diagnosis
    C. Clinical Pulmonary Disease
    D. Coronary Artery Obstructive Disease

Section B: Structured questions. (*Answer the following questions by writing your answers in the space provided*).

1.1. The diagram shows a model which can be used to demonstrate breathing.



(a) Name the part of the body represented by

(i) the balloon

.....[1]

(ii) the glass tube A

.....[1]

(iii) the glass tube B

.....[1]

(iv) the sheet of rubber.

.....[1]

(b) When the rubber sheet is pulled down the balloons inflate. Explain how this is caused.

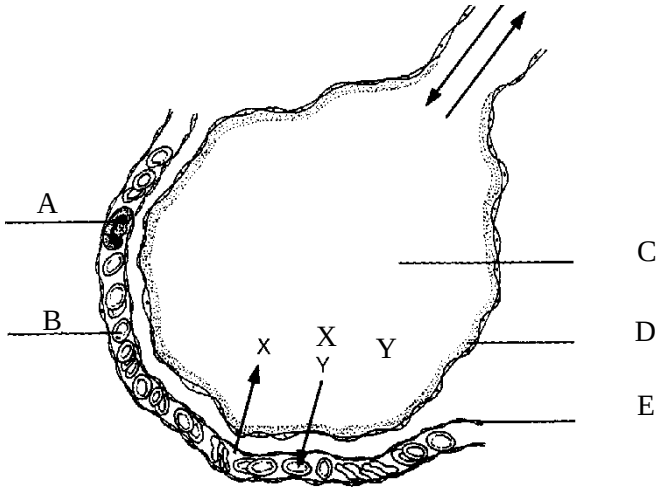
.....

.....

.....[3]

1.2.The diagram shows a section through an alveolus and a surrounding blood vessel.

Z



(a) Name the parts labelled A, B, C and D.

A ..... B .....

C ..... D .....[4]

(b) What type of blood vessel is E?

.....[1]

(c) Name the gas moving in the direction shown by

(i) arrow X. .....[1]

(ii) arrow Y. .....[1]

(d) Name the process by which gases pass across the alveolar walls.

.....[1]

(e) What do the arrows Z represent?

.....[1]

(f) What happens to oxygen once it has entered the blood?

.....

.....[2]

(g) The air breathed into the body often contains dust and bacteria. How are these prevented from entering the alveoli?

..... [3]

TOTAL MARKS: {40}

APPENDIX B: FOCUS GROUP DISCUSSION GUIDE

The focus group (learners' reactions) from the experimental group.

Opening statement.

I thank you all for permitting me to involve you in these discussions. These discussions consist of five open-structured questions that seek to get your views about the effects of improvised instructional materials that the researcher used during the teaching process. Furthermore, you are assured that your responses to the interview questions will be treated with the outmost confidentiality and the pseudonym that you acquired at the beginning of the study will be used instead of your real name.

What do you understand by the word "improvised"? (the researcher will give the meaning if the children do not know it).

……

……

1. What do you think of being taught with improvised instructional materials?

……

……

2. What do you like most about being taught with improvised instructional materials?

……

……

3. What is that you disliked most about being taught with improvised instructional materials?

……

……

4. In general, did improvised instructional materials help you understand the topic ‘gas exchange in humans’ better?

……

……

5. Do you recommend improvised instructional materials to continue being used in Biology? Specify why.

……

……

……

APPENDIX C: LESSONS

LESSON NOTE

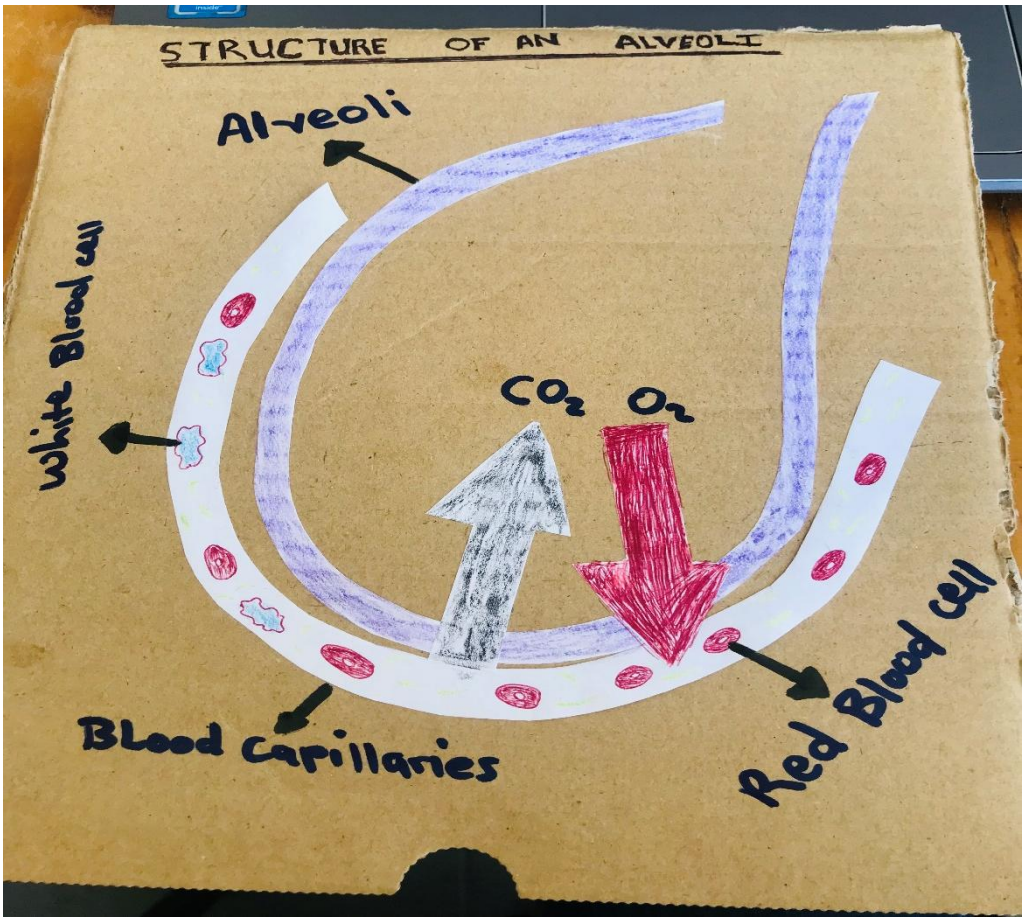
Teacher: Johannes Shipepe	**Grade:11**	**Date:**
Subject: Biology **50** min **Theme and Topic:** Human body (Gases exchange in humans)		**Time:**

Teaching Materials:

- Bottle, tubes, and plastic-made model of breathing system. **(Group A only)**

A breathing system model (improvised instructional material)

Structure of an alveoli (improvised instructional material)



- Teachers 'notes

Lesson Objectives:

- Distinguish between breathing and respiration.
- List the features of gas exchange surfaces in humans.
- state the functions of internal and external intercostal muscles and cartilage in the trachea.
- explain the differences in composition between inspired and expired air.

Learners should be able to:

- Know the role of intercostal muscles and trachea.

Monitoring of homework done:

- No homework was given.

Introduction:

- Teacher writes the objectives on the board and asks what learners know about the topic to be discussed from the previous grades.

Presentation:	
TEACHER	**LEARNER**
• Breathing is the muscular mechanism which is applied to transport air containing oxygen from the external atmosphere to the lungs (inhalation), and air containing carbon dioxide from the lungs to the external atmosphere (exhalation). • Gaseous exchange is the diffusion of oxygen from the alveoli to the blood capillaries, and the diffusion of carbon dioxide from the blood capillaries to the alveoli. • Respiration is the release of energy from food substances (like glucose) in all living cells 24/7 (in the mitochondria) • Nitrogen -it is insoluble, not absorbed into the blood and not needed for respiration. Hance 78% is retained after exhalation. • Oxygen- it is soluble, absorbed into the blood and used in respiration. Hance only 16% of the 21% is exhaled. • Carbon dioxide- it is a waste product of respiration which goes from the alveoli out of the lungs. Hence 4% is exhaled instead of 0.04% that was inhaled. ✓ Air in alveoli contains higher concentration of oxygen, than in blood. • Air in the alveoli contains a lower concentration of carbon dioxide, than blood. • Concentration gradient exists	• Label different body parts that made up the respiratory system. • Observe inhalation and exhalation on a respiratory system model (group A only).

	between the air and the blood. • Oxygen diffuses into blood capillaries; carbon dioxide diffuses out. • There are many alveoli. • This provides a large surface area. • The alveoli have a thin wall made of one epithelial layer of cells. • The alveoli are surrounded by network of capillaries. • Capillaries also with thin wall with one layer of epithelial cells. ✓ Gaseous exchange surfaces must have a large surface area – the millions of alveoli in the lungs provide a surface area of 70 m2. • The surface must be thin for easy exchange of gasses by diffusion – the walls of the alveoli as well as the walls of the capillaries are made of only one single layer of epithelial cells. • A gaseous exchange surface must have an efficient transport system for oxygen and carbon dioxide – all alveoli are surrounded by a capillary network. • The gaseous exchange surface must always be moist – inside the alveoli is a moisture layer to keep it open and prevent drying out. • There must always be a concentration gradient between the air in the alveoli and the blood – it is maintained because blood is pumped through the lungs and constantly moving through capillaries.	• Take notes and ask questions.

Homework
➢ Define breathing. (1) ➢ Distinguish between inhalation and exhalation. (2) ➢ Explain the composition of air that is exhaled and inhaled. (4)

LESSON NOTE

Teacher: Johannes Shipepe	**Grade:11**	**Date:**
Subject: Biology **50** min **Theme and Topic:** Human body (Gases exchange in humans)		**Time:**
Teaching Materials: • Bottle, tubes, and plastic-made model of breathing system. **(Group A only)** • Teachers 'notes		
Lesson Objectives: • Investigate the differences in carbon dioxide concentration in inspired and expired air, using limewater and/or hydrogen carbonate indicator solution. • Explain the effects of physical activity on the rate and depth of breathing. • Describe the effects of tobacco smoke on the gas exchange system with reference to carbon monoxide, nicotine, and tar. • State that tobacco smoking can cause chronic obstructive pulmonary disease (COPD).		
Learners should be able to: • Understand the significance of physical activities on the rate and depth of breathing.		
Monitoring of homework done: • Peer marking the homework and give corrections.		
Introduction: • Teacher writes the objectives on the board and asks what learners know relating to the previous lesson.		

Presentation:	
TEACHER	**LEARNER**
• Carbon dioxide test - When CO2 is bubbled through clear lime water, the lime water turns milky. The hydrogen carbonate indicator turns from red to orange-yellow in the presence of CO2. • At rest, a healthy adult person breathes about 16–18 times per minute, using the diaphragm only. During exercise, this rate automatically rises to 20–30 times per minute and the intercostal and abdominal muscles will come into operation as well. The rate and depth of breathing increase. A greater volume of air with more oxygen will be exchanged at a given time. This ensures that the active muscle cells are supplied with extra oxygen. This means that faster respiration will occur in the muscle cells. The faster respiration means that more energy will be released for the muscle cells during exercise. The faster breathing means that more carbon dioxide will be excreted at the same time. • Tar - Tar damages the cilia in air passages which causes them to stop their flicking (beating) movements. This prevents the sweeping out of dust, bacteria, pollen, and mucus.	• Learners observe the experiment of carbon dioxide testing in exhaled air in a video on a projector. • Observe the effect of tar in a video on human lungs.

• Nicotine - It increases the stickiness of platelets, and this increases the risks of blood clots. • Carbon monoxide - CO combines with haemoglobin to form carboxyhaemoglobin in red blood cells. • COPD - Chronic Obstructive Pulmonary Diseases	
Evaluation: ➢ Give two effects of nicotine on the breathing system. (2) ➢ Define COPD (1)	

APPENDIX D: ETHICAL CLEARANCE CERTIFICATE

UNAM
UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: WKC0030 **Date: 15 August 2023**

This Ethical Clearance Certificate is issued by the University of Namibia Decentralized Ethics Committee (DEC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the **School of Education (Windhoek & Khomasdal Campuses) Decentralized Ethics Committee**.

Title of Project: Investigating the effects of using improvised instructional materials on grade 11 learners' achievement in biology at a school in Omuthiya circuit.
Researcher: Shipepe Johannes
Student number: 201403758

Take note of the following:

1. Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the ethics committee. An application to make amendments may be necessary.
2. Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the ethics committee
3. The Principal Researcher must report issues of ethical compliance to the ethics committee (through the Chairperson) at the end of the Project or as may be requested by the ethics committee
4. The ethics committee retains the right to:

i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,
ii) Request for an ethical compliance report at any point during the course of the research.

The ethics committee wishes you the best in your research.

Dr. Job U. Hengari (Chairperson, Windhoek & Khomasdal Campuses Decentralized Ethics Committee)

Prof. Davis Mumbengegwi
(Head, Multidisciplinary Research)

APPENDIX E: RESEARCH PERMISSION LETTER

REPUBLIC OF NAMIBIA

OSHIKOTO REGIONAL COUNCIL

Tel: (065) 242500 **DIRECTORATE: EDUCATION, ARTS & CULTURE** Private Bag 2028
Fax: (065) 240315 ONDANGWA
Enquiries: Ms Tende 29 August 2023

Ref: 13/2/9/1

Mr Johannes Shipepe
PO Box 13548
Rehoboth
Email: shipepejohannes7@gmail.com

Dear Mr Shepepe

RE: PERMISSION TO CONDUCT A RESEARCH STUDY

The Office of the Director acknowledges receipt of your letter seeking for permission to conduct a research study focusing on "*Investigating the effects of using improvised instructional materials on grade 11 learners' academic achievement in Biology*". A case study of a Secondary School in Omuthiya Circuit.

Kindly be informed that permission has been granted to carry out the research in Oshikoto Region, please be guided by the following:

- You have to consult the school principal well in advance to ensure a proper co-ordination of other school activities
- The research should not interfere with the normal teaching and learning process at the school.
- Participation in the research should be on a voluntary basis.
- The information to be collected should be treated as confidential and only for research purposes.

Thank you for showing interest to do the research in the Oshikoto Region. It is our sincere hope that the information you would gather will be useful towards the completion of your qualification.

Sincerely yours

Director
2023 -08- 31

MS ALETTA A. EISES
DIRECTOR OF EDUCATION, ARTS AND CULTURE
OSHIKOTO REGION

APPENDIX F: POSTGRADUATES OFFICE PERMISSION LETTER

CENTRE FOR RESEARCH SERVICES
Office of the Pro-Vice Chancellor: Research, Innovation & Development
University of Namibia, Private Bag 13301, Windhoek, Namibia
[illegible]
[illegible]

UNAM

RESEARCH PERMISSION LETTER

Date: 28/11/2023

Student Name: SHIPEPE JOHANNES

Student Number: [illegible]

Programme: MASTERS OF EDUCATION (SCIENCE EDUCATION)

Approved Research Title: Investigating the Effects of Using Improvised Instructional Materials on Grade 11 Learners' Achievement in Biology at A School in Omuthiya Circuit.

TO WHOM IT MAY CONCERN:

I hereby confirm that the above-mentioned student is registered at the University of Namibia for the programme indicated. The proposed study met all the requirements as stipulated in the University guidelines and has been approved by the relevant committees.

The proposal adheres to ethical principles as per attached Ethical Clearance Certificate. Permission is hereby granted to carry out the research as described in the approved proposal.

Best Regards

Dr. AEE Shikongo
Head: Postgraduate Research Support Services
Tel: +264 61 206 3129
E-mail: aeshikongo@unam.na

CENTRE FOR RESEARCH SERVICES
Office of the Director
2023 -11- 28
University of Namibia
UNAM

APPENDIX G: CONSENT FORM FOR PARENTS

Enquiries: Mr. Johannes Shipepe Education Department
Cell: +26481 7655731
Email: shipepejohannes@gmail.com
University of Namibia
30 June 2023

Dear parent
INVITATION TO PARTICIPATE IN A STUDY
This communication is an invitation for you to grant your child permission to take part in this study. I am a Part-time student pursuing a master's degree in education in science education at the University of Namibia, Windhoek campus. To fulfil the requirements for the degree of Master of Education, I am currently conducting a research project, which aims to 'investigating the effects of using improvised instructional materials on grade 11 learners' achievement in Biology at School X in Omuthiya circuit.

The researcher will divide learners into two equal groups, **A** and **B**. The two groups will be administered with a pre-test that aim to assess learners' level of performance in Biology at the beginning of the study. Afterward, Learners will then be taught for two weeks in lessons of 40 minutes, with group **A** to be taught with improvised instructional materials, textbook, and teachers' notes while group **B** will be taught with textbook, and teachers' notes only. A post-test will be administered to all groups after two weeks to see if there is a change in the level of performance of learners in the groups.

As a result, I am requesting your permission to allow your child to participate in this life-changing learning experience. Please fill and sign the accompanying declaration form to give your consent. Furthermore, please keep in mind that his/her participation

in this study is voluntary, and the use of pseudonyms will ensure anonymity. Likewise, he/she reserves the right to withdraw from this study with no penalties. The study's findings will be published and presented in academic and professional settings. Please feel free to contact me at any time if you have any questions about this research**.**

Yours Sincerely

_____

Johannes Shipepe

M.Ed. student

University of Namibia

Declaration form

I_____ (full names of a parent/guardian) thus acknowledge that I understand the contents of this paper and the nature of the educational intervention. As a result, I grant permission for my child _____ to participate in this research study.

_____ _____

Signature (parent/guardian) Date