BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF SCIENCE EDUCATION

BACHELOR OF SCIENCE EDUCATION HONOURS DEGREE IN CHEMISTRY

[HBSc. Ed. in Chemistry]

EXPLORING THE TEACHING AND LEARNING OF ORDINARY LEVEL COMBINED SCIENCE PRACTICAL COMPONENTS IN RURAL AREAS.

A RESEARCH PROJECT SUBMITTED BY

KAUNYE THULA

STUDENT ID NO: B211523B

A RESEARCH PROJECT SUBMITTED TO BINDURA UNIVERSITY OF SCIENCE EDUCATION IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF THE HOUNOURS DEGREE IN CHEMISTRY

NAME OF SUPERVISOR: **DR. MUNYARADZI CHIDARIKIRE**

SEPTEMBER 2022

`

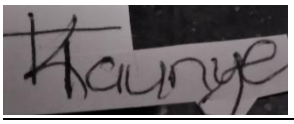
DEDICATION

This work is dedicated to the Almighty God who gave me wisdom and guidance and also my loving family and husband.

`

DECLARATION

I Thula Kaunye, hereby declare that the work contained in this project is my original work and has not been previously submitted to this or any other university or institution.



Student Signature — Date: 27/09/2022

pp.

Supervisor Signature — Date: 15/12/2025

ACKNOWLEDGEMENTS

My sincere love and gratitude goes to the Almighty God for he gave me life, the priceless love, strength and wisdom. My appreciation goes to the Faculty of Science Education lectures, with special thanks to my supervisor Dr Munyaradzi Chidarikire (PHD) who tirelessly guided me in conducting this project with his constructive criticisms and encouragement. I thank you for your support during my academic life at Bindura University of Science Education. I also wish to express my heartfelt thanks to my family and participants for the continuous tireless support, guidance, love and patience during my professional studies.

Finally, I give thanks to the Almighty God. "Unless God builds the house the builders will labour in vain" Psalms 127.

ABSTRACT

The study sought to analyse the teaching and learning of 'O' level Combined Science practical components at secondary school in Zimbabwe. The research further sought to establish ways of enhancing effective teaching and learning of practical components such that it produces employable and self-reliant school graduates. The study was motivated by the increasing numbers of the school leavers who were unemployable and could not sustain themselves through use of locally available resources. The study adopted a qualitative research approach which was considered appropriate in the study. A detailed case study approach using key informant interviews and questionnaires was utilized to solicit information pertinent to the study. Purposive and convenient sampling methods were employed to select the research participants. The research study also used simple random sampling. The study used emerging themes as the data analysis method. It revealed that the teaching and learning of practical components in secondary schools is marred with a lot of challenges in Zimbabwe. The study established that teachers were not competent enough to deliver Combined Science curriculum in Schools. This was a result of the type of training teachers received during training which was no longer congruent with the technological advancement which had taken place in the Science and Technology School curriculum. It was also instituted that schools were producing students who lacked the hands on skills necessary for them to be acceptable in the world of work. There was a stern shortage of equipment, tools, chemicals and machinery in Science departments in schools. The machinery and equipment in the departments were too old and broken. Furthermore, the study established that there was no collaboration between schools and industries. It was also established that learners were discontented by the teaching methods that teachers were using. Learners conveyed their desire for the industry to be involved in teaching and learning in schools. Based on the above findings, the study concluded that teachers were in capacitated to deliver Combined Science practical components due to the training they received in colleges and universities which was not congruent in the dynamics of technology. The study also concluded that the shortages of machinery and equipment also demotivated teachers and incapacitated them. It was also concluded that the lack of collaboration between schools and industries posed serious challenges to both learners and teachers. The study recommends that the quality of the existing teaching force must be improved mainly through extensive staff development training programs. There was need for teachers to be staff developed through training workshops in order to improve their competences. There should be collaboration among school management, teachers and the industry during curriculum design to improve their sense of ownership of Combined Science programs. To improve on learner's acquisition of skills the study recommended that time for work integrated learning should be lengthened so that students leave the secondary school level equipped with relevant skills and knowledge.

Key words: Exploring; Combined Science; Practical components; Challenges.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

CHAPTER 1

THE PROBLEM AND IT'S SETTING

1.0 Introduction

This chapter covered the background of the study, statement of the problem, major research question, main research objectives, sub research questions, assumption of the study, significance of the study, delimitations of the study, limitations of the study, definition of key terms and the summary of the chapter

1.1 Background of the study

The science curriculum at any time and place is determined by the existing theories and ideas about the nature of science. As such theories and ideas have varied from place to place and from time to time, even for the same place, the science curriculum and its introduction have never remained static. Several programmes had been set up in various parts of the world to develop science curriculum and teaching with an aim to suit the prevailing situation in such areas (Ramli, Talib, Manaf and Hasson, 2017). As a result of these changing views about science, its content and materials have been subjected to a lot of modifications in accordance with the reigning theories and environments.

In a research carried out in Ghana, the use of English language as a medium of instruction and inadequate instructional resources were reported as important challenge to science teaching and learning in Ghanaian rural schools as observed by the researchers (Anamuah-Mensah; Ananga; Wes brook; and Kankam, 2017). This is because students have to comprehend scientific concepts taught and engage in hands-on activities, critical thinking, and problem-solving in the teaching and learning of the subject. Ghana is a multilingual country with English, a colonial legacy as the social language for its citizen. English language is the medium of instruction for teaching and learning all subjects including Science from Primary Four in the school system (Quansah, Sakyi-Hagan and Essiam,2020). This meant that success in education at all levels depends, to a very large extent, on the individual's proficiency in the English language (MoESS, 2017).

`

The use of the English language could unintentionally impair teaching and learning of Science, especially to the secondary school learner. In the teaching and learning of science, pupils are encouraged to express their ideas and question evidence in scientific investigations as they developed their concepts in science. Thus, for a learner to understand scientific concepts and express themselves effectively using the concept that learner must have a high level of proficiency in the language used to present the concept. Tan and Tan (2018) and Azure (2015) stated that learning in a second language is considered challenging when learners experience difficulty in deducing the meaning of Mathematics and Science concept words.

In another case study in Ghana done by Joana, Selase, Selorm and Emefa (2015), it was revealed that one major objective of Ghana's educational system was to equip individuals with employable skills to enable them contribute meaningfully towards the development of the nation. Joana et al (2015) also noted that practical teaching hours in science and technology syllabus should be increased. They went on to say learning science practical skills was an important part in preparing young students particularly women for occupations related to technical and practical roles. In a similar case study carried out by Manwa (2018) in Masvingo revealed that the teaching of subjects such as Science, ICT and Garment construction required self- motivation since there was need for the teacher or student to apply herself or himself more seriously in order to produce good products or service. Manwa and Motsi (2018) went on to say practical learning experiences were emphasized as students applied the skills or techniques to make samples or projects. This showed that motivation is vital for positive attitude to practical components in learning.

In recent years there had been a growing focus on the need to better prepare students for higher education and arm them with the skills and knowledge they would need to be successful innovators in a 21st century workforce (Tan and Tan,2018). Science Education had gained popularity among educators, parents, corporates and institutions, as well as a way to fulfill this need. Previously, learning was centred on imparting theoretical knowledge, but the demands of the global economy as well as technology revolution led to the realization that there was an urgent need to focus on hands-on skills if our learners were to survive competitively in the global village (Joana et al ,2015). For instance, the teaching of Integrated Science ZGCE Code 5006 at

‘O’ level (Zimbabwe) focused at providing pupils with an alternative to practical (written) assessment paper which only test the memorization and familiarity of pupils with the laboratory procedures (ZGCE, ‘O’ level syllabus, 2011-2020). Teaching relevant, and demand skills that will prepare students to become innovators in an ever evolving world was therefore paramount, not only for the future of these students but for the future of the country. Therefore, education should not be solely the ingestion of information, but the development of skills so that students can adapt to an uncertain world.

The lesson that needed to be learned here was that, if we wanted our learners to succeed in life, we could teach them how to think critically and solve problems. The best way to do that was to provide them with a good foundation in science education. We are all familiar with the adage “give a man a fish and you feed him for a day; teach a man to fish and you feed him for a lifetime.” Too often we fed our students instead of teaching them how to feed themselves. This led to the setting up of the Nziramasanga, Presidential Commission of enquiry in education and training in Zimbabwe (Mupinga, Burnett and Redman, 2015).

Nziramasanga Presidential Commission of enquiry noted that, at independence secondary education was academically satisfactory but failed to cater for the majority of students, neither did it prepared them for the necessary skills needed in the world of employment (Nherera, 2015). Having established the above facts, the commission of inquiry made several recommendations to redress the shortcomings of the education system of the time. The commission recommended the introduction of science and technology in the secondary school curricular such that it could cater for various talents and interests of the Zimbabwean children. As a result, the curriculum was made relevant to the needs of the children and the nation’s developmental needs (Mupinga et al 2015).

The introduction of Combined Science in 2018 was a move to improve the practical components in science education in secondary schools 5(Ministry of Primary and Secondary Education Combined Science Syllabus Secondary school level, Form 1 -4, 2015-2022). In other words, Science and Technology was intended to give learners an opportunity to learn practical skills at an advanced stage giving them various entrepreneurial skills and opportunities after school. This was done after the government had realised that there was need to make adjustments to the

technical subjects in order to sustain the demands of the industry (Gumba, 2015). This meant that there was need to move from domestic oriented to industrial and design oriented. To this end, Mathew (2017) noted that the technical, vocational and science education sustained the technological and industrial growth of the nation's economy. According to policy curricular number 77 of 2018 all secondary schools in Zimbabwe were obligated to teach combined Science at secondary school level to all learners, and rural learners were not spared.

In the Science discipline at ordinary level, the outgoing syllabi in Integrated Science assessed practical skills mainly through an alternative to practical component (ZIMSEC Examiner Report, 2018). The practical papers were there on the scheme of assessment but had low takers. In 2016 the majority of learners (213 983) studied Integrated Science as compared to 7 194 for Chemistry (ZIMSEC Examiner Report, 2017). The trend was similar when compared with other pure sciences for the past 30 years. Of the 7 194 Chemistry candidates only 431 took the practical test (Chireshe, 2022). It has to be noted that Integrated Science denied many learners to proceed to Advanced level or to a science related career (Ta,2018). The majority of schools (learners) taking the pure sciences were opting for the alternative to practical component (Dakwa, 2018). The question then was "were we really teaching/assessing science for economic and technological advancement or were we teaching the History of Science?" Alternative to practical assessments had been criticized for assessing learning at lower levels of intellectual complexity, and at higher levels such critical thinking and analysis were not fully assessed (Mupinga et al 2015). Other critiques argued that the education system was producing half backed science graduates who could not wire a three pin plug for example (Zenda,2018). Graduates who lacked science practical, technical and investigative skills were ill equipped for progression to higher education, employment in science related fields, and for solving real life problems (Mupinga et al 2015). Currently, Zimbabwe relies mainly on developed countries such as China, Japan, Korea and Malaysia on Technology in spite of the large number of learners taking Science at Ordinary level (Ta,2018). Tooth picks for example are imported from China as if there are no trees in Zimbabwe.

According to Manwa and Motsi (2018), educating students in Science, if taught and assessed correctly, prepares students for life, regardless of the profession they choose to follow. Science is

more than a school subject, or the periodic table, or the properties of waves. It is an approach to the world, a critical way to understand and explore and engage with the world, and then have the capacity to change that world. In a world where success is driven by what you can do with what you know, it's more important than ever for our youth to be equipped with the knowledge and skills to solve tough problems (Ramli etal, 2017). They can gather and evaluate evidence, and make sense of the information. These are the types of skills that students could acquire when they are exposed to science practicals.

Practical work is defined as a "hands-on" learning experience which prompts thinking about the world in which we live. Other scholars defined it as teaching/learning activities which involved learners in observing and manipulating objects and materials (Akuna and Callaghan, 2016). The Practical activities were made up of two major phases; Data collection and data interpretation. The term, Practical work is more applicable than "Laboratory work" because location is not a critical feature in characterizing this kind of activity. Observing and or manipulation of objects does not necessarily require a Laboratory, this can be done anywhere, in an out of school setting, in the field or an ordinary classroom (ZIMSEC Handbook for centers, 2019). Laboratories are expensive to construct and equip. Most of our Centres did not have adequate resources to acquire standard school laboratories hence the need to use ordinary classrooms (ZIMSEC Examiner Report, 2017).

Research had reported that, when done well, practical work can:

- stimulate and engage learners
- improve learners' scientific knowledge
- encourage learners to be independent and more self-reliant
- enable learners to participate confidently and effectively in the modern world "scientific literacy"
- enable learners to acquire an understanding of hazard, risk and safe working
- provide the foundation for further study

- enable learners to acquire a range of practical (planning, manipulation of equipment, observation, data collection, recording and presentation, analysis, evaluation) analytical and critical thinking skills. (Combined Science Teachers' Guide ,2015- 2022).

Most rural schools still possessed remnants of the ZimScience initiative of the 1980s and the recent UNICEF science kits (Ta,2018). What remained was insufficient to cover both the large groups of learners and diverse topics covered under the combined science curriculum. ARTUZ noted that, some schools didn't even have a building called a science laboratory and those who had a room it was just an empty shell (The Herald, 2018). They added that Electricity and water were rare commodities in rural schools. One therefore wonders where and how these practical components could be conducted in rural schools. Many researchers have identified that, the quality of science teaching and learning could be affected by many factors including content knowledge and pedagogical skills of the teacher due to poor teacher preparation, inadequate, and inappropriate instructional materials, medium of instruction, lack of effective supervision and monitoring at school, lack of motivation for teachers, and inadequate number of qualified teachers to fill empty classrooms, poor attitude, and interest of pupils among others (Anamuah-Mensah et al., 2017; Fredua-Kwarteng and Ahia, 2015; Ngman-wara 2015; Azure,2015).

All learners in Zimbabwe were now supposed to sit for a Combined Science Practical examination, thus according to the dictates of the new curriculum (Ministry of Education, 2018). The move was plausible as practical science investigation gave learners hands on experience of the content they would have theoretically learnt in class. Life skills were also mastered which are vital in the drive to use Science education to stimulate economic development (Ta,2018). However, if the initiative was not supported by requisite infrastructure, skilled manpower and related material resources, practical science examinations could brew a disaster of unimaginable proportions. According to the Amalgamated Rural Teachers Union of Zimbabwe (ARTUZ), the bulk of learners lacked appreciation of the basic laboratory glassware equipment and reagents (The Herald, 2018). Common glassware like beakers could not be identified by those learners who were expected to use the same in the examinations.

Combined Science syllabus develops learners' basic scientific skills in Physics, Chemistry and Biology (Combined Science Teachers' Guide ,2015- 2022). It develops knowledge,

understanding and practical application of basic scientific concepts and principles as well as the ability to handle information and critical thinking (Ministry of Primary and Secondary Education, Combined Science syllabus, Secondary school level Forms 1-4, 2015-2022). Learners could gain practical experience and leadership skills through individual and group experimental work (Ta,2018). It also imparts practical skills such as handling of apparatus, chemicals, plant and animal specimens safely and confidently (Combined Science Teachers' Guide ,2015- 2022). These were practical tests that teachers could give to learners once a month. They could be individual or group activities. The tests should cover manipulation of apparatus, following procedure, collection, presentation, analysis and evaluation.

The aims of the combined Science syllabus were to enable learners to:

i. provide an opportunity to develop desirable scientific literacy
ii. promote critical thinking, creativity and problem solving skills that apply to real life situations
iii. develop scientific practical skills, accuracy, objectivity, integrity, enquiry and team work.
iv. develop attitudes relevant to science such as self-initiative, self-managing and enterprising
v. relate scientific practices to sustainable use and extraction of value from our natural resources
vi. participate in the technological development of Zimbabwe and the global world, (Ministry of Primary and Secondary Education, Combined Science syllabus, Secondary school level Forms 1-4, 2015-2022). This shows how the practical component is crucial in the learning and teaching of science subjects. The practical component is allocated the same weighting as the Multiple Choice paper in Combined Science as opposed to Integrated Science where only 20% weighting was allocated to practical's (written).

Table 1.1: Weighting of Assessment in Combined Science:

Paper	Type of paper	Duration	Marks	Weighting

1	Multiple choice	1hr	40	30%
2	Theory	2hrs	100	40%
3	Practical	1hr 30mins	40	30%

Source: Ministry of Primary and Secondary Education, Combined Science Syllabus 2015-2022

It is, therefore, essential to investigate these challenges confronting Combined Science teaching and learning so as to strengthen learners' performance in science. The findings of the study would help uncover measures needed to address the challenges and improve the performance of pupils in the Zimbabwe General Certificate of Education (ZGCE), 'O' level in the rural communities in Zimbabwe. To that end literature seemed to show paucity of studies that focuses on the teaching and learning of 'O' level practical components in Combined Science focusing on Zimbabwe's rural communities which were the basis to the aims of the subject area.

1.2 Statement of the problem

Science and Technology education is currently a worldwide phenomenon and in forefront of education systems in different countries. Studies showed that Science and Technology education is echoed worldwide. According to Leithwood (2020) and Mathew (2017), countries worldwide had committed themselves to Technical Vocational education and Science and Technology in a bid to improve the learning and teaching of practical work and be able to fit well in the world of work. However, Combined Science was introduced with more emphasizes on the teaching and learning of practical components to enable learners master skills and knowledge for later use in industry and society.

ARTUZ noted that the government of Zimbabwe was running a teacher capacity building exercise at different levels (The Herald, 2018). There was an exercise conducted in partnership with UNICEF. This exercise was catering for Science teachers to advance their knowledge through advancing education. Teachers were enrolled for Post Graduate Diploma in Education programs, Subject specific undergraduate programs and Masters programs (Ministry of Education, Sports and Culture, 2018).

Despite efforts made so far, the Science and Technology thrust in the secondary school curriculum seemed not to bear much fruit, as not all science education professionals were retrained in line with the new focus on science and technology (TellZim, 2020). Most school leavers would face challenges in the society as they failed to meet the industry standards, being creative or being entrepreneurs as required by the aims of the subject area (Ministry of Primary and Secondary Education, Combined Science syllabus, Secondary school level Forms 1-4, 2016-2022). This study sought to explore the teaching and learning of combined science practical component in Zimbabwe's rural secondary schools and make appropriate solutions for effective teaching and learning for improved performance and self –reliance.

1.3. Major research question

How is Combined Science practical component being taught at "O" level in rural areas?

1.4 Sub-research questions

1.4.1. What instructional materials are available to assist the teaching and learning of Combined Science practical components at 'O' level in rural areas.

1.4.2. What are the challenges pupils and teachers face with the teaching and learning of Combined Science practical components at "O" level in rural secondary schools?

1.4.3. How can the practical components be taught at 'O' level for improved performance and self-reliance?

1.5. Research Objectives

The above research questions sought to address the following objectives:

1.5.1. To identify instructional materials being employed to teach combined science practical components at ordinary level in rural areas.

1.5.2. To determine the challenges being faced in the teaching and learning of combined science practical components at "O' Level in rural secondary schools.

1.5.3 To establish the ways of improving the teaching and learning of combined science practical components at 'O' Level in rural secondary schools.

1.6 Assumptions for the Study

The study assumed that challenges faced in the teaching and learning of combined science practical component had significant effects on the learner's performance in the subject area, society and industry.

It was also assumed in this study that the researcher's previous experience in education would not interfere or incorporate bias that could affect the results of the study. It was further assumed that respondents to this study could answer survey questions honestly and to the best of their abilities.

1.7 Significance of the study

There were several valuable benefits expected by implementing this study;

1.7.1. **To Teachers**

Teachers benefited more during interview sessions as they responded to various questions on in-service training. This educated them on the importance of personal development through in-service training and became relevant to future technological advancement in society.

1.7.2. **To Learners**

Learners would adapt to the ever-changing technological environment as they use the information gathered from the study. As a result, they could realise the importance of practical components in the subject area and develop positive attitude towards the subject. Learners could start constructing meaningful products at home and maybe selling them for money.

1.7.3. **To Researcher**

The findings of the study could stimulate the researcher for further research on practical components thereby increasing skills and information in the body of knowledge.

1.8 Limitations

The researcher had limited time since the research project was carried out while schools were open, which made it difficult for the researcher to conduct research whilst at work. During the study some of the learners were occupied with their school work, thereby the researcher could not have enough time to do observation as scheduled. The researcher also could have involved a

number of schools but due to lack of funds and time to move around, only two schools will be involved. The researcher then worked overtime during weekends and after hours to do the research with the learners.

1.9 Delimitations of the study

The research was carried out from the two schools (Chinyika Secondary school and the neighbouring Takura Secondary School) in Goromonzi district, Mashonaland East province. This made it easy for the researcher considering the financial crisis that the researcher had. The researcher could travel on short distances between the two schools as they are within proximity. Due to geographic constraints, the researcher was unable to sample all the schools doing combined science in the province. However, the researcher could ensure that the data collected was sufficient to draw substantial findings, conclusions and recommendations.

1.10 Definition of key terms

1.10.1**. Combined Science**

The Combined Science learning area covered basic concepts in Biology, Chemistry and Physics. The syllabus covered science concepts such as observing, recording, measuring, presentation, interpretation of data and analysis. It also imparts practical skills such as handling of apparatus, chemicals, plant and animal specimens safely and confidently. (Ministry of Primary and Secondary Education, Combined Science Syllabus FORMS 1 – 4 2015 – 2022).

1.10.2. **Practical components**

These are learning activities that involve hands on participation when teaching and learning. Other scholars define it as teaching/learning activities which involved learners in observing and manipulating objects and materials (ZIMSEC Handbook for centers, 2019; Akuna and Callaghan, 2016).

1.11 Summary

It was indicated in the background that Combined Science is a development from integrated Science where the practical component was replaced by an alternative to practical which was a written component. Combined Science was introduced to give a focus on enhancing learners practical exposure (hands on approach) in order to meet the challenges in industry and become self-reliant. The chapter also gave limitations and delimitations of the study. The study was of significance to teachers, learners and the researcher. The next chapter revealed related literature.

CHAPTER 2

REVIEW OF RELATED LITERATURE

2.1 Introduction

This chapter presented a review of the literature on the learning and teaching of the practical components in Combined Science at 'O' Level. The chapter focused on how the practical components prepares learners for self-reliance. It also reviewed the tools and techniques used by both teachers and learners in the teaching and learning of practical components in the subject area. The level of skills being offered by the teachers in teaching Combined Science practical was also reviewed. This chapter is divided into two sections. The first section focused on the empirical literature review that guided the study. The second section looked at the review of the related literature on major issues on the delivery of Combined Science curriculum in Zimbabwean secondary schools.

2.2 Empirical literature review

In the empirical literature review, findings and recommendations from other researchers on the topic were analysed and new ideas were established in this research. The literature review was based on the teaching and learning of 'O' Level Combined Science practical components at secondary schools. Main focus was on the importance of practical components to learners as they prepare for the world of work.

2.2. 1. Instructional resources and materials for science teaching

In the classroom, teachers have a variety of options in the techniques and tools they could use to teach each topic (Ogaga (2016). Every teacher needed supplies and resources in order to have a successful classroom. Eze (2018) added that, writing utensils, paper, and inspirational wall signs are all useful objects in a classroom, but they are not instructional materials. Instructional materials are the tools used in educational lessons, which includes active learning and assessment (Gbadamosi, 2018). Basically, any resource a teacher uses to help him teach his students is an instructional material. From a 21st century, post-pandemic point of view, teaching aids and instructional materials can be considered as "learning and teaching resources" for a hybrid online-offline educational setting (Eze,2018). They are now mostly screens and computers connected via the internet (teaching aids) and educational media (instructional materials). Munje, and Jita, (2020) pointed out that, technological changes have merged the concepts of teaching aids & instructional materials in ways that old definitions did not foresee. The teacher uses and applies the different kinds of instructional materials in teaching and absolutely it provides great advantages to the teaching-learning process. According to Deshmane, (2016), instructional materials facilitate teaching and learning activities and consequently, the attainment of lesson objectives. Moreover, Ajoke (2017), stated on a study in Edo State, Nigeria that the success of teaching and learning of practical components in science and technology is attributable to proper use of instructional materials and resources.

In another study carried out in Nigeria by Ogaga (2016), in spite of the desire for technological development, couple with the fact that Science is a very vital subject for technological development, the poor performance of students in secondary schools in Kwara State education had been attributed to so many factors. These factors included, poor facilities, inadequate and poor quality teachers and non-availability of instructional materials amongst others particularly in Ifelodun Local government Area (Zuze, 2016). As a result of some of these factors, the morale and interest of the students in biological science became low (Bello, 2015)). This is because teachers adopted the verbalistic and theoretical method as a way of teaching and learning the subject, mainly due to non- availability of instructional material in schools especially rural communities (Ajoke, 2017; Gbadamosi, 2018; Ofodu and Oso ,2015).

2.2.2. Challenges pupils and teachers face with the teaching and learning of Combined Science practical components at "O" level in rural secondary schools

Kolb defined learning as a process whereby knowledge is created through the transformation of experience and it involves the gaining of abstract concepts that can be applied well in a variety of situations (McLeod, 2017). Kolb's experiential learning theory is a holistic perspective that combines experience, perception, cognition and behaviour. There are four stages of learning cycle that represent Kolb's experiential learning theory as explained by David (2017). These stages include: (1) concrete experience whereby a new experience is encountered or reinterpretation of existing experience. (2) Reflective observation of new experience of particular importance and any inconsistencies between experience and understanding. (3) Abstract conceptualization reflection gives rise to a new idea, or a modification of an existing abstract concept. (4) Active experimentation whereby the learner applies them to the world around them to see what results (Mcleod,2017). These stages emphasised the important role experience plays in the learning process. The theory proposes that learners need to be actively involved in the experiments and reflect on the experiments for them to gain knowledge from it and be able to apply what they learned in the real world.

Despite the importance of practical work as explained in Kolb's experiential learning theory, there were several factors preventing science teachers, especially at rural secondary schools from including practical work in their teaching routine (Deshmane, 2016). In performing practical works at schools, there could be various challenges, which might affect the achievement of the exit learning objectives. For example, Silas, Abah and Mashebe (2019) had observed some challenges in the Oshana region, Namibia, which were mainly associated with curriculum implementation namely, the lack of equipment, insufficient timetable time for practical work, lack of safety precautions in the laboratory and learners' participations, large number of students, none availability of resources, and the absence of trained laboratory assistance.

In another study carried out by Sylvester Donkoh in Ghana, in rural Africa, schools did not just lack good buildings, they also lacked funding and social amenities, such as electricity and internet connectivity (Donkoh,2016). The 'harsh' conditions in rural communities in general made teachers refuse postings to such places or seek transfer to urban areas and so many schools in rural communities were under staffed (Dumba, 2016).

2.2.3 Tools and techniques required for effective teaching and learning of Combined Science practical components.

For effective teaching and learning of practical components to take place, there is need for the provision of enough tools and good teaching instructional materials. Ashty, (2020), in their international journal of science education and development in Ghana emphasized that, teachers who use greater variety of instructional techniques and support their teaching with instructional materials were more likely to promote greater learning among learners. They went on to say teachers use instructional materials such as real objects, graphs, specimen, pictures, sketches, diagrams, handouts, magazines, mood board, overhead projectors as tools that facilitate and influence teaching and learning (Quansah etal, 2020). For example, in science and technology learners can be able to conduct experimental activity whilst using real objects or overhead projectors.

Mupa and Chinooneka (2015) in their journal of education and practice stated that variety of teaching and learning materials in scheming and planning promote effective teaching. Mupa etal (2015) also said lecturers must be knowledgeable, have greater understanding of what students should learn, set clear and achievable aims and objectives, choose and use variety of appropriate and suitable teaching techniques and materials to achieve effective teaching and learning in practicals. This meant that teachers must use a variety of teaching tools in order to cater for all learners when teaching practical. In a case study carried out by Rwadziso (2018) at Midlands State University it was noted that the shortages of textbooks, apparatus, proper laboratories and other things required for the learning of Science, Technology and Design made it hard for the learners to like the subject as they knew that they would face difficulties in doing their work. Rwadziso (2018) went on to say that, for implementation to be a success the necessary resources should be present. This meant that for learners to be well equipped there is need for adequate practical tools, (Omuna, Onchera, and Kimutai ,2016)

2.3 Instructional Materials and Resources for Science teaching and learning

Science is a great enterprise which nations depend on in-order to advance technologically. Science therefore, is receiving much emphasis in education because of its significance and

relevance to life and society (Abdu-Raheem, and Oluwagbohunmi, 2015). Science had been regarded as the bedrock of modern day technological breakthrough. Nowadays, countries all over the world, especially the developing ones are striving hard to develop technologically and scientifically, since the world is turning (Mupira and Ramnarain, 2018). According to Botes (2021), Science is a dynamic human activity concerned with understanding the workings of our world. This understanding helped learners and teachers to know more about the universe and that is why science subject like computer science, biology, agriculture, physics and chemistry are taught in secondary schools. Importantly, effective teaching of any subject could not only stimulate student's interest in the subject but also enhance their achievement in the examination (Mupira and Ramnarain ,2018). To achieve effective teaching and learning process, there is the need for use of instructional materials (Botes,2021). Instructional materials are the different teaching aids or apparatus which a classroom teacher employs to facilitate his or her teaching for the achievement of the stated objectives (Ofodu and Oso, 2015). Omuna, etal (2016) defined instructional materials as those materials which are helpful to the teachers and students and which maximize learning in various areas.

Instructional materials range from home made devices to sophisticated machines. (Salazar and Larenas, 2018). Since the sense organs of pupils were gateways to learning, materials provided learners the opportunity to become actively involved intellectually, perceptually and physically in the instructional process (Mtsi and Maphosa, 2016). The National Teachers Institute (NTI) teacher training manual quoted in Salazar and Larenas (2018), categorized instructional materials into print materials, audio-materials, audio-visuals, static/displays and electronic materials. The materials were derived from various sources, including collection of items from the community, improvised materials by teachers and pupils, distribution of materials by government and non-governmental organizations, donations from various agencies and creation of resource centres (Du Plessis and Mestry ,2019). Any effective utilization of instructional materials, requires the instructional process to be organized with a combination of people, materials, facilities and equipment for the realization of stated learning objectives.

A study by Mzuza and Van der Westhuizen (2019) found that in the Northern Cape province, which is the largest and most sparsely populated province of South Africa, many schools in rural

and disadvantaged areas were plagued with Science classrooms. These classrooms were not well-equipped with the deemed Science teaching models and equipment. This echoed the view of other scholars such as Du Plessis and Mestry (2019), who claimed that ill-resourced Science classrooms characterized a significant number of South African schools in rural and disadvantaged areas. In addition, studies by Mabasa and Singh (2020) and Mupira and Ramnarain (2018) shed light on the outdated science-teaching models that were not aligned to the current national school curriculum, also referred to as the Curriculum and Policy Statement document.

Given the reality of ill-resourced Science classrooms in selected schools in the Northern Cape province, national scholars (Fleischmann & Van der Westhuizen, 2017; Mupira and Ramnarain, 2018; Nkambule and Mukeredzi, 2017) and international scholars (Aadland, Espeland and Arnesen, 2017) called on teacher development programmes to be intentional in developing pre-service teachers' capability to develop and utilise improvised teaching models as a means to complement their model-based teaching approach during teaching practicum opportunities. This, as a result, impacted negatively on the ability of science pre-service teachers to follow a model-based teaching approach, since science instructional materials and models in these classrooms were either non-existent, outdated, or irrelevant to the current Science school curriculum (Du Plessis and Mestry, 2019; Mabasa and Singh, 2020; Mtsi and Maphosa, 2016).

2.3.1. What are Instructional Materials?

So what are instructional materials? Every teacher needs supplies and resources in order to have a successful classroom. Writing utensils, paper, and inspirational wall signs are all useful objects in a classroom, but they are not instructional materials. Instructional materials are the tools used in educational lessons, which includes active learning and assessment (Ajoke,2017). Basically, any resource a teacher uses to help him teach his students is an instructional material.

Examples of instructional materials include books, pamphlets, games, maps, textbooks, musical scores, notebooks, films and videos (Botes,2021). Abdu-Raheem and Oluwagbohunmi (2015) also pointed out that, instructional materials can also include manipulative items for in-class lessons such as protractors, safety goggles, T-squares, blocks, chalk, models, pencils, rulers and art supplies. Using a variety of instructional materials allows students with different learning

preferences to access the content being taught and increases the likelihood that all students learn effectively. There are many types of instructional materials, but let's look at some of the most common ones.

2.3.2 Traditional Resources

According to Abdu-Raheem (2016), traditional resources include any textbooks and workbooks used in the classroom. For example, language arts classrooms always have literature textbooks, writing textbooks, and even vocabulary and spelling workbooks. In addition to these, traditional resources also include any supplemental reading material, like novels or poems outside of the textbook.

These materials can really help to introduce new concepts to your students. For example, when learning the concept of theme, a literature textbook could provide numerous reading materials all displaying theme in different types of literature (Okori and Jerry, 2017). In the same way, Ajoke (2017) said workbooks can give some useful basic practice activities for a new vocabulary words or even writing activities that might be difficult for students. Then, when mastery is shown on a basic level, a teacher could introduce more challenging material related to that concept. Examples of traditional resources are; lectures, talks, writings, project rubrics, guidelines, textbook primers, reference books, extra-readings, teacher and student-created summaries, workbooks, supplementary material such as flashcards and charts (Mukuda,2017).

To evaluate these traditional resources, Abdu-Raheem (2016) argued that, the most important aspect is to make sure you choose material within the resource that appropriately relates to your learning objective. Most textbooks and workbooks have already been designed to align with certain educational standards and are therefore very reliable in regards to addressing classroom goals (Ajoke,2017). Still, it is important to be sure to choose material within the textbooks that matches your specific learning objective.

2.3.3 Graphic Organizers

A second type of instructional material is the graphic organizer, which is any type of visual representation of information (Zenda,2017). He added that, diagrams, charts, tables, flow charts, and graphs are all examples of graphic organizers. For instance, in a science classroom, it is

essential to use graphs on a coordinate plane when learning about the conversion of measurements so that students can actually see how a line is graphed. In language arts, Venn diagrams and plot diagrams are clear instructional tools to use when comparing or analyzing events in a piece of literature. Salazar and Larenas (2018) added that, all of these graphic organizers allow students to physically see relationships between ideas. This is imperative for learning, especially for students who are more visually oriented. Seeing a clear relationship is always easier than an abstract idea in your mind.

2.3.4 Teacher-Made Resources

According to Ajoke (2017), this type of instructional material comprised any teacher-made resources. He added that, these materials included anything the teacher creates, like handouts, worksheets, tests, quizzes, and projects. In collaboration, Abdu-Raheem (2017) agreed that, many of these materials were used for assessment in the classroom, which is determining the level of learning on any given topic. For instance, different handouts or worksheets could be used throughout a unit to see which students are getting it and which students are struggling. Okori etal (2017) argued that, evaluating these materials is very important. Everything a teacher creates must be a true assessment of the learning objectives. For instance, a test on a more advanced novel needs to show how a student can apply the concepts of theme, character development, conflict, and other literary ideas covered in that unit. In this case, simple recall of plot events should take a lesser role in any teacher-created assessments.

2.3.5 The importance of instructional materials in teaching and learning Science practicals

The importance of instructional materials in teaching and learning cannot be underestimated. A lot has been written to show the indispensable role of materials in curricular implementation. Instructional materials made learning more interesting, practical, realistic and appealing (Botes,2021). They also enabled both the teachers and students to participate actively and effectively in lesson sessions. They give room for acquisition of skills and knowledge and development of self- confidence and self- actualization (Abdu-Raheem,2016). Ajoke (2017) observed that teaching aids are important for practical and demonstration in the class situation by

students and teachers. Chikuta (2016) saw instructional materials as devices that assist the teacher to present a lesson to the learners in a logical manner. In their own perspective, Salazar and Larenas (2018) saw instructional materials as visual and audio-visual aids, concrete or non-concrete, used by teachers to improve the quality of teaching and learning activities. Vhumba (2019) submitted that instructional materials of all kinds appeal to the sense organs during teaching and learning. Eze (2018) also described instructional materials as objects or devices that assist the teachers to present their lessons logically and sequentially to the learners. All this pointed out that instructional materials are used by teachers to aid explanations and make learning understandable to students during teaching learning process. Ashma (2020) asserted that non-availability and inadequacy of instructional materials are major causes of ineffectiveness of the school system and poor performance of students in schools.

According to Abu-Raheem and Oluwagbohunmi (2015), the advantages of instructional materials are that they are cheaper to produce, useful in teaching large number of students at a time, encourage learners to pay proper attention and enhance their interest. Eze (2018) also described instructional materials as objects or devices that assist the teachers to present their lessons logically and sequentially to the learners. Burutsa (2015) acknowledged that instructional materials are such used by teachers to aid explanations and make learning of subject matter understandable to students during teaching learning process. Okori etal (2017) supported that instructional materials are very significant learning and teaching tools. They suggested the needs for teachers to find necessary materials for instruction to supplement what textbooks provide in order to broaden concepts and arouse students' interests in the subject.

Ajoke (2017) identified non-availability, inadequacy and non-utilization of learning materials as a result of teacher's poor knowledge as factors responsible for the use of lecture method. They recommended that both the students, teachers, parents, Parents/Teacher Association, government and philanthropists should be involved in improvising instructional materials for the teaching and learning in schools. Therefore, Akuna (2016) advocated for of teachers' resourcefulness and also encouraged them to search for necessary instructional materials through local means to supplement or replace the standard ones. Zenda (2018) also agreed that the best way for teachers

to make use of their manipulative skills is to improvise so as to achieve their lesson objectives at least to a reasonable extent.

Fleischmann and Vander Westhuizen (2017) also identified the importance of instructional materials as making learning concrete and real, substitutes one thing for another, allows the students to participate in the production of materials, economical and more teacher-student resource oriented. Abdu-Raheem (2016) submitted that improvisation of locally made teaching aids could assist to improve quality of graduates turn out from schools and standard of education generally. Abdu-Raheem and Oluwagbohunmi (2015) also corroborated the idea that resourceful and skillful teachers should improvise necessary instructional materials to promote academic standard in Nigerian schools. In other words, testing and assessment not only helps to confirm the learning of content but also helps improve the learning. Research had shown that being tested (the testing effect) can promote memory and conceptual understanding (Abdu-Raheem,2016). Attempting worksheet exercises, quizzes, essays, etc. reinforce learning as well as create a hub for further self-motivated learning. By fully utilizing these resources, teachers or a learning facilitators, can make the lessons rich and fun for the students.

2.4. Challenges in teaching and learning of practical components

Research showed that practical work is plagued with a number of challenges which impede the effective learning and teaching of the components (De & Dutta, 2015). De and Dutta (2015) conducted studies on challenges in practical work in Home Economics and Science. The study revealed that inadequate learning resources was a serious challenge facing the teaching and learning of practical work in the area under study (Chaora, 2020). De and Dutta (2015) ‘s study also concluded that, most learners stated that practical subjects’ teachers, especially women, are too harsh and intolerant when they are stressed. As a result, learners were averse to choosing practical tasks. In Olayinka’s (2016) study findings revealed that students were concerned about the shortage of teachers with technical skills.

Furthermore, Kuyenda (2016) studies showed that, a shortage of adequate equipment for practical lessons was also revealed as a major challenge facing the teaching and learning of

practical work in science subjects. Lack of well-equipped science laboratories and inability of teachers to improvise instructional materials hindered the teaching and learning of the subject (Ngman-Wara,2015). These obstacles were also found in Silas,Abah and Mashebe (2019) study in the teaching and learning of natural science practicals in the Oshana Region in Namibia. The study also revealed that, inadequate instructional materials, lack of improvisation on the side of teachers and utilization of teaching aids, as well as inadequate laboratory constituted problems to the teaching and learning in the science subject. Gamawa (2015) also found that inadequate funding, especially by government was a challenge facing the practical classes in sciences. Aluka (2018) further revealed that learners who chose science and technology subjects such as home economic were expected to provide necessary equipment on their own with limited support from government. This gave rise to lack of interest in the subject and many parents were also discouraging their children from doing the subject because it is capital intensive.

There were other reported problems associated with incentives, which include the value of practical work held by students, teachers and curriculum developers and lack of reward for the students (Shona, 2017). Ngman-Wara, (2015), was of the opinion that practical work is regarded as one of the most challenging task for science teachers and thus, not practised frequently or efficiently in many science classrooms. According to Silas etal (2019), the issues of health and safety, risk management and cost are among the significant factors limiting fieldworks. The available textbooks and charts are not enough to promote effective teaching and learning of Science practicals, so most of the concepts are explained for pupils to memorize (Azure, 2015). Again, (Quansah etal, 2019) agreed that, the textbooks may outline, describe phenomenon, and show pictures about things and what they would observe in the outlined practical activities. This mode of teaching does not encourage a hands-on approach to learning for pupils (Lucksone, 2019. It also deprives pupils of taking responsibility for their learning through active construction and reconstruction of their meanings for concepts and phenomena (Ngman-Wara,2015).

2.4.1. Skills Teachers Possess in teaching of Combined Science curriculum

The quality of teaching staff is a major determinant of the quality of graduates the schools produce and their eventual impact on the world of work and economic development (Mushonga, 2015). There is generally shortage of experienced and qualified teachers in Zimbabwean schools for the practical subjects (Chimhenga ,2015). Most schools that offer science subjects in rural communities lacked qualified staff (Zandile, 2019). The shortage has led to the use of unqualified teachers which perpetuates the vicious circle of poor teachers producing students who do not meet the standards required in the world of work. In Zimbabwean schools, many teachers have left the teaching profession to escape the worsening economic situation with hyperinflation having turned their salaries into pittances (Mlambo, 2018). The same authors further alluded that most of these academics got employment opportunities with better remunerations in neighbouring countries like Botswana and South Africa and others have gone to Britain and the United States to further their education. Donkoh (2016) defined brain drain as the movement of high level experts from developing countries to industrialized nations. Brain drain is the loss of human knowledge, experience, skill and expertise from one area, region, country or geographical location to another (Knight, 2018). It usually occurs from developing to developed countries (Kutukwa, 2019). There are many reasons why highly skilled professionals choose to migrate.

The unavailability of seasoned and highly qualified teachers is a major cause for concern in secondary schools. Research showed that the last decade had witnessed institutions of learning in Zimbabwe losing large numbers of key professionals because of a brain drain (Mushonga, 2015). This brain drain had therefore become a serious challenge in attempts to improve the quality of science and technology in Zimbabwe. As Chimhenga (2015) noted, those who remained behind watched themselves become academically stagnated and incapacitated and the majority of them were being comforted by the security provided by a teaching post. The same author further alluded that there was need for competent teachers to teach science subjects so as to achieve quality in science and technology at schools. This crisis had left Zimbabwe ‘s education system in tatters (Asnesu, 2015). However, it has been noted with great concern that this problem is not peculiar to secondary schools only but to all the colleges of higher learning. Key to the success of science and technology programme is teachers’ competence and attitude. In support of this

view, Rogan and Grayson (2015) stipulated that, teachers' capacity is a critical factor if quality results are to be realized in schools.

The Nziramasanga commission (1999) in Mupinga etal (2015) also found out that in universities, the lecturers were under qualified for their jobs. This is a big challenge to quality assurance in the delivery of science and technology Education (STEM) in universities. While the university curriculum is diversified to include vocational courses, frequently the teacher training curriculum had continued to emphasize on academic courses (Komolafe ,2016). This created a knowledge gap between the lecturer and the curriculum in universities and ultimately, with the world of work. As a result, this hindered the delivery of the science and technology curriculum for lecturers lacked the necessary skills for them to deliver TVE. For lecturers to be competent there was need for them to have good communication skills. This aspect of lecturer's competencies does not spare teachers for science subjects at secondary school level.

2.4.2. Importance of Skills for Teachers

According to Mwakalinga (2021) teachers should possess a teaching qualification. This meant that before entering a class every teacher should possess his or her qualification to show his or her effectiveness. Foster, Quarcoo, Ashong and Land (2017) stated that teachers should be competent enough to enable them teach the right skills to students. This means that they should have enough knowledge to impart right skills to the learners. Teacher's capability influence student's learning outcomes. Rogan and Grayson (2015) also said that teacher's years of experience and quality of training is correlated with the children's practical achievements.

The skills which the teachers had to know and impart to students are manipulative skills and accuracy processes that is taking measurements, handling of dangerous chemicals and apparatus, as well as recording observations and correct results (Knight, 2018). This means that the teacher should have the skills on how to mix dangerous chemicals and carry out experiments. The teacher should also know all the apparatus and chemicals required to carry out an experiment. Foster, etal (2017) noted that teacher competencies in the teaching and learning of practical components can be measured by the ability to impart knowledge and practical skills to students.

According to Mupinga etal (2015) a competent teacher should be able to impart technical skills to students in order for them to produce products of high standard. Kadziya and Ndebele (2016) said that it is assumed that if one has a teaching qualification he or she may be able to cater for student diversity by using appropriate teaching assessment methodologies.

Komolafe (2016) stated that for science education to be effective, teacher quality should be good, while the right infrastructure and the teaching and learning material should also be available and adequate. Kuzomuka (2020) added that, teacher should promote auto learning than to make himself to become the source of learning. Teachers are expected to be able to structure their content and pedagogy to suit the cultural environment of their learners since the environment in which they acquire skills for teaching may be completely different from that of their learners (Davis ,2015). This can only work if the teacher has got enough knowledge and skills on the subject. According to Davis (2015) the emphasis was more on the acquiring of skills than understanding and knowing the scientific principles of the subject.

The teacher need to be more creativity when teaching practical components. This is important because when designing one needs to be more creativity. Another issue pertaining lecturer competence is the issue of their experience in the teaching field (Mupinga etal,2015). Knight, 2018) espoused that competent lecturers are masters of their subject matter, exhibiting great expertise in the subject they teach. According to Rogan and Grayson (2015) they were supposed to have been exposed to various teaching methodologies and assessment techniques that could be used to cater for student diversity. According to Chimhenga (2015), being a lecturer of this programme required one to have a complete knowledge and understanding of what to teach and ability to teach it well to elicit the effectiveness. Adams (2015) added that practitioners need to have skills in four areas which are relationship building, exploring or probing, empowering and challenging. Dewey (2016) also said an essential additional skill is the ability to gain and utilize knowledge from practice. Kugonda (2016) believed that teachers' practical knowledge could serve as a valuable resource for enhancing educational theory.

2.5. Tools and teaching techniques required for effective teaching of Combined Science practical components.

The main aim of tools and techniques is to improve the productivity of the organization by optimum utilization of organizational resources, men, materials and machines (https://textile learning> tools-tech). Techniques are methods used in teaching and learning for it to be effective. According to (Kahu and Nelson 2017), effective learning takes place where there is reflective practice. Practical work in the school science curriculum had become the nucleus of curriculum reform initiatives which had taken place worldwide. In line with this development the Tanzania education system had taken on board the design practical as a cornerstone in its bid to make practical teaching and learning more responsive to global trends and expectations (Mwakalinga,2021). According to research study carried out by Mwakalinga (2015), Tanzania had a centralized education system so all schools follow the same national curriculum. Azama (2019) added that, the suggested teaching methods were participatory teaching methods that involved hands on activities and maximum interaction during the teaching and learning process. These methods are experimentation, discussion, role play, KWL methods, futures wheels, jig saw, gallery walk and many others (Mwakalinga,2021; Kola, and Langenhoven, 2015). Unfortunately, the teaching methods which were largely used were the traditional ones (Teacher centred) like lecture and demonstration methods. The use of these teaching strategies were attributed to low weighting of the design practical question, lack of staff development workshops, and designing question requiring recall of facts rather than student initiative, lack of experience as examiners, lack of knowledge and skills (Miles, 2015).

Progressive educators believe in pupil centred education that is active participation of pupils in the teaching and learning process. In a classroom, pupils have got different learning abilities some are auditory, visual and kinaesthetic (Liu, and Kleinsasser, 2015). Auditory learners are those that learn very fast through listening. These learners will understand the message through discussion and when there is one pupil answering the question. Visual learners are those that understand the message through visualizing direct to the information. Kinaesthetic learners are those who understand the information through feeling an object that is hands on.

Ali, (2015), also supported this by saying when pupils are learning they learn by actively participating in observing, speaking, writing, listening, thinking, drawing and doing. This means that a good teacher should not follow one style or theory, but use a polytheistic approach to ensure effective teaching and learning. That is the electric approach. According to Brown (2015) electric is more useful as it integrates all methods, approaches and techniques and applies a certain method, approach or technique, which is suitable to the classroom environment. This allows the teacher to choose the methodology which suit the learners. The learner centred approach is being applied in all secondary schools as it makes learners to be eager to learn and they become more attentive (Kahu, and Nelson, 2017; Umugiraneza). It maximizes child's passion for learning and accommodates child's style. Kahu, and Nelson (2017), states that it blends listening, speaking, reading and writing in teaching and learning process, which will be achieved through multiple tasks, high interaction, lively learning and fast results. Bansilal, and North, (2018) also said that the use of instructional materials facilitates learning processes as they bring the real meaning of what is being taught to light. Abu-Raheem (2016) also said for more effective results any instructional materials that lecturers choose as enhancement for their teaching should be suitable and relevant to the teaching strategy and learning packages. In a case study carried out by Forster, Quarcoo, Ashong, Land and Ghanney (2017) in Ghana it was noted that teachers should always be encouraged to use hands on instructional approach such as demonstration, project based methods and field trips.

Abu-Raheem (2016) noted that lecturers of Science and Technology who combine two or more teaching methods including demonstration and practical lesson are likely to be more successful and effective than their counterparts who only use one teaching method. Okori etal (2015) suggested that demonstrations enable learners to evoke the wow experience. This made learners to have curiosity in learning and increase their reasoning abilities. Demonstration encourages generalization because it promotes active participation on the parts of students (Kola & Langehoven, 2015). Samkange (2015) also noted that demonstration encourages students' involvement, since they are less teacher oriented and give student an opportunity to produce questions to become more active in the learning process. Dewey (2016) also reported that students can illustrate cognitive strategies by observing the teacher as he or she thinks out loud while doing the demonstration.

Demonstration lesson are very important in this regard thus while lecturers demonstrate, students see and get to know what is expected of them in the field of their own practice and products development (Samkange,2015). Through demonstration lesson, students are assisted to understand some difficult terms and new techniques thereby making the learning packages real to them (Komolafe ,2016). Teachers should also use project based learning during teaching and learning of practical components. The following are tools and techniques employed for effective learning and teaching of Science practicals;

2.5.1 Project based learning

In a case study carried out by Silverman and Jelenewicz (2017) in USA, it was noted that various educators have recommended problem-based learning to provide students with guided experiences in learning through solving complex, real world problems. Komolafe (2016) stated that project based learning is a teaching approach that engages students in sustainable collaborative real world investigations. Komolafe (2016) went on to say projects are around a driving question and students participate in a variety of tasks. Kahu, Nelson, and Picton, (2016), define project based learning as a model that organizes learning around projects. Bansilal, (2015) stated that traditional learning in classroom based education is being challenged by the ever increasing complexity in our lives and societies. This means that in teaching and learning of practicals most teachers prefer project based learning which has got more hands on when learning. According to Kola and Langehoven, (2015), project based learning focuses on developing critical thinking, problem solving and to improve skills in the students. This means that during teaching and learning of practical components when learners are given projects they are being given problems to solve on their own and produce results by the completion of the project.

For example, the continuous assessment project (CALA) which is being done at 'O' level, it enables learners to become active in learning. Chitukwa (2015) supported this by saying project based learning prepares students to solve the real world problems. Project based learning greatly impacts the development of interpersonal skills of the students (Miles, 2015). This is because projects which are being given to learners, are more complicated than the work which is being

given in the traditional classroom based learning therefore it in -stills skills and techniques. Ajoke (2017) also noted that project based learning develops greater depth of understanding the concepts than in traditional classroom based learning and results in improved levels of student's creativity. This means that learners will become more creativity through project based learning.

Bello, (2015) also said that students have opportunities to develop skills of observation, survey, research, reporting, presentation, communication and collaboration with people involved, team building and leadership in the end problem solving approach of project based learning. Miles, (2015) states that giving a project to students is better nowadays, rather than making them sit in a class and speaking it all out for them. Project based learning makes learners to have a better understanding of the topic. Umugiraneza etal, (2018) also noted that project based learning prepares learners for the workplace, increase motivation, connect learning at school with reality, providing opportunities to contribute to their school or community, increase self-esteem and allowing children to use their individual learning strengths and diverse approaches to learning and providing a practical, real-world way to learn to use technology. In other words, project based learning encourages active participation, acquiring of skills and creativity to learners.

2.5.2 Field trips

According to Berer (2016) field trip is a journey taken by a group of people to a place away from their usual environment. Buks (2018) went on to say in education field trips are defined as visits to an outside area of the normal classroom and made by a teacher and a student for purposes of first hand observation. Whitesell, (2015) stated that educational field trips help the teachers to clarify, to establish, correlate and coordinate accurate concepts and enable teachers to make learning more concrete, effective, vivid and meaningful. It went on to say through educational field trips most of the concepts and phenomenon may be easily clarified, understood, assimilated and with the help of this, good deal of energy and time of both the teachers and students can be saved.

Fink (2020), said that going on a field trip is a wonderful way to extend a learning experience, in such a way that the students not only understand the concept, but also understand how it

connects to their world. Reeves and Rodrique (2016), noted that, field trips are vital for students to have a chance to view and explore historical places and different social institutions. They went on to say they provide an opportunity for the students to view a new place, meet new people, seeing and understanding the things. For example, in Combined Science, when learners visit factories they will see the actual laboratories and factories in real time and learn how they work practically. Fink (2020), also said that educational field trips are helpful in completing the triangular process of learning that is motivation, clarification and stimulation. Julian (2018) argued that when educational field trips are undertaken by students of an educational institution the main aim is not only recreation and pleasure but also gain additional knowledge through direct experiences. This supports the different learning styles required by students through practical demonstration of how equipment operates. Kelly (2019) went on to say educational field trips give students the opportunity to have first-hand experiences and explore the world. Whitesell (2015) argued that field trips enrich, vitalize and compliment content areas of the curriculum by means of first hand observation and direct experience outside the classroom.

According to Bello, (2015) field trip is a substantive way to expand student's horizons and allow them to learn experimentally. Perry, (2015) added that, field trips are hands-on, real world experiences, quality of education, positive attitude to science and motivation towards the subject, improvement of the socialization between students which would impinge into the classroom and development of rapport between teachers and students, enabling teachers to utilize other learning strategies such as cooperative learning. Educational field trips are a progressive method of learning by which students go through the necessary learning experiences under the leadership and guidance of the teacher (Pareek, 2019; Bello, 2015).

2.5.3 Advancement of technology

2.5.3.1. ICT

Learners should move with technology. The teaching and learning of Science education involves various skills and techniques hence the need to apply information communication and technology to enhance effectiveness in the study (Newase, Sheetlani and Patil ,2017). ICT is the infrastructure and components that enable modern computing (https.//searchcio.techtarget.com.). ICT encompasses a diverse set of technological tools to identify and organize data and

information. It involves a wide range of technologies which includes telecommunication technologies such as telephone, television, video conferencing and computer mediated conferencing (Deshmane, 2016). A research by Uwameiye (2016) in Nigeria explained the meaning and concept of ICT in detail. Yeboah, Abonyi and Luguterah, (2019) explained information as facts or details about something while communication are the methods by which it is delivered and technology is the practical application of science or the art of applying scientific knowledge to practical problems. This means that ICT can be effectively used by learners in combined science where most of the problems have to be solved practically. Abu-Raheem (2016) concluded that, teachers and learners should use ICT in the teaching and learning of science and technology since it is a skill oriented subject with potential to equip individuals with basic skills and knowledge for self-employment.

According to Newase etal (2017) the use of ICT fastened both practical and theoretical teaching and learning of science and technology, for example use of iPhones, iPads, you -tube and internet of things. This means that teachers and learners can use iPhones, iPads, touch application to help students with their practical. Abu-Raheem (2016) concluded that the utilization of ICT in Nigeria has many benefits which include multiple sensory deliveries, increased self-expression and active learning, co-operative learning, promoting critical thinking, enhanced communication skills, multicultural education, individualisation and motivation. Schools promote the use of ICT in teaching and learning by offering free training in the key (https://www.infodev.org). This means teachers can be trained at colleges or universities and if not, heads of schools can ask teachers to use ICT and will keep on upgrading themselves in ICT. Keen learners can be utilized in demonstrating the use of ICT and this will motivate other learners.

2.5.4. Importance of workshops

According to Kola & Langenhoven (2015), workshops introduces new ideas and inspire participants to further explore on their own. This means one can be able to improve his or her work. Mwangu, and Sibanda (2017) stated that through discovering new teaching strategies, through professional development for teachers, educators can go back to the classroom and make changes to their teaching styles and curricular to better suit their students need. Professional

development for teachers can help them to plan their time better and stay organized which lead them to be more efficient and gives them extra time to focus not on paper work but students (Davis, 2015). Workshops are a good opportunity to learn new skills and familiarise with certain topics which one do not know well. Davis, (2015) also noted that workshops provides a way to create an intensive educational experience in a short amount of time. It is a great way to teach hands on skills because it offers participants a chance to try new methods and fail in a safe situation (Newase etal, 2017).

2.5.5. In-service training

In service education can be defined as the relevant courses and activities in which a serving teacher may participate to upgrade his or her professional knowledge, skills and competencies in the teaching profession (Chimhenga,2015). According to Deshmane, (2016), in service education is staff development which is deliberate and continuous process involving the identification and discussion of present and anticipated needs of individual staff for furthering their job satisfaction and career prospects and of the institution for supporting its academic work and plans and implementation programs of staff activities designed for the harmonious satisfaction of these needs. Donkoh (2016) noted that teachers are regarded as the hub of educational development, therefore in - service education is concerned with the activities and courses in which a serving teacher may participate for the purpose of upgrading his professional skills, knowledge and interest.

In a case study carried out by Osamwonyi (2016) in Nigeria it was noted that many teachers engage in one form of in service training or the other to cater for their inadequacies and extend their professional competencies. Rogan and Grayson (2015) also said that in service education of teachers should be seen as a necessity to achieve the national objectives of the educational system. In a case study carried out by Junejo, Sarwar and Ahmed (2017) in Karachi Region it was noted that in service training is a long term investment to develop skills and professionalism of teachers.

According to Bruns (2017) teacher development is important for any organization as well as for any country that holds the targets of improvement in their capacity building. Quansah etal (2019) noted that in service training programs make teachers equipped with logical systematic approaches to apply in classes. Deshmane, (2016) said that the fundamental purpose of in service teacher training is to create an environment that enables the effective practice of teaching within a classroom. Junejo etal (2017) noted that in service training programs make teachers equipped with logical and systematic approaches to apply in classes. In other words, it helps to improve professional competencies.

The need for in-service training in schools is getting more attention for teachers to equip with new knowledge and skills for them to face new challenges and information in education. In -service training can enhance the professionalism of teachers who can contribute to the organization to achieve its goals (Bruns, 2017). In-service training provides with self-development where one will be well equipped with skills and knowledge. According to Davis (2015) in-service training can also change the attitude and skills of teachers and further increase the performance of students. Osamwonyi (2016) also noted that further training of lecturers is necessary in order to meet the ever complex student diversity entering higher education institutions and the ever increasing industrial demands.

2.5.6 How to prepare learners for self-reliance.

According to Nziramasanga report of 1999, the government of Zimbabwe has realized that the economy of Zimbabwe needs more hands on technical jobs, causing the implementation of a new curriculum which came with practical components in the teaching and learning of Combined Science at Secondary level (Mupinga etal,2015). Kadziya and Ndebele (2016) also noted that the aim of these practical learning areas is to enable learners to acquire knowledge, skills and techniques for meeting their personal and societal needs. This calls for the need for the implementation of Science and Technology practical components to enhance learners with the relevant skills and knowledge.

A case study in Ghana done by Joana, Selase, Selorm and Emefa (2015) stated that one major objective of Ghana's educational system is to equip individuals with employable skills to enable

them contribute meaningfully towards the development of the nation. Joana et al (2015) also noted that practical teaching hours in science and technology syllabus should be increased. They went on to say learning science practical skills was an important part in preparing young students particularly women for occupations related to technical and practical roles. In a similar case study carried out by Manwa (2018) in Masvingo revealed that the teaching of subjects such as Science, ICT and Garment construction required self- motivation since there is need for the teacher or student to apply herself or himself more seriously in order to produce good products or service. Manwa (2018) went on to say practical learning experiences are emphasized as students apply the skills or techniques to make samples or projects. This shows that motivation is vital for positive attitude to practical components in learning.

In another case study carried out by Azure (2015) in Ghana, it was noted that science studies programme is technical based, therefore the students are expected to be trained and equipped with employable skills, competencies and knowledge that will make them capable of fulfilling the manpower needs of the nation to earn a meaningful living and contribute to the improvement of the socio-economic development of the nation. Yeboah, Abonyi and Luguterah, (2019) went on to say, students are expected to have key skills in creativity and innovation, fair to produce new variants of knowledge, ability to research, absorb and synthesize ideas and skills and the talent of being good entrepreneurs. In this case, the role of education was not only to enhance learning capabilities among students but also develop values that could enable them to become productive self-reliant, civic minded as well as to be mentally, emotionally and physically fit citizens (Chief Examiner's Report in Ghana ,2019). Quansah etal (2019) in their journal also stated that it is imperative that students in professional programs be able to put into practice what they have learned in the classroom.

Vocationalisation of secondary school education is a considered curriculum change in a vocational or practical direction, which attempts to make young persons more opt to take up employment directly after leaving school as wage-earners or self-employment (Mathew, 2017). According to Dewey (2016) education should equip learners with knowledge to master and solve problems that the environment raises for them in the process of living. (Uwameiye, 2016), also noted that learners should be given theory and practice for productive adult roles outside the

classroom on a lifelong basis. That is learners should be taught according to their environment so that they will be able to utilize the learned aspects in their everyday life (education for living).

2.6 Summary

The chapter sought to establish what available literature has to say about the topic under consideration. It reviewed the key issues which have a direct bearing on the teaching and learning of practical components in Combined Science at 'O' level. The next chapter looked at research methodology.

CHAPTER 3
RESEARCH METHODOLOGY

3.1 Introduction

This chapter highlighted the research methods and techniques which were utilized in order to realize the objectives of the study. The research was qualitative in nature. Aspects described included the research approach, research design, research population, sample, sampling procedures, research instruments, data collection procedures, credibility, trustworthiness and data presentation and analysis.

3.2 Research Approach

Grounded in the qualitative research approach, the research design chosen for the current study was phenomenography, which uses a naturalistic approach that seeks to understand phenomena in context – specific settings (Patton, 2015). Phenomenography is a qualitative research framework which focuses on understanding perceptions of reality rather than understanding

reality itself (Pruzan, 2016). The goal of phenomenography is to identify, describe or make statements and assertions about participants' ideas and experiences (Grix, 2018). The researchers adopted the interpretive paradigm because it enables access to perspectives, knowledge constructions and understandings from inside the meanings of participants and therefore also embody those persons' contextual meanings. Interpretivist researchers seek to gain access to the developed meanings that participants bring to experiences and that entails the broad cultural and experiential worlds from which those individual's perspectives and beliefs were formed (Ratiman, 2017; Pruzan, 2016). Within the interpretivism perspective, researchers tend to gain a deeper understanding of the phenomenon and its complexity in its unique context instead of trying to generalize the base of understanding for the whole population (Pham, 2018).

A research approach is the structure of research. It is the glue that holds all the elements in a research project together (Creswell & Creswell, 2017). In this study qualitative research approach was employed. Qualitative research refers to an approach for exploring and understanding the meaning of individuals or groups to a social or human problem (Yeboah, Abonyi & Luguterah,2019). The qualitative research approach dealt with intangible aspects such as attitude and perception of the society. Qualitative research provides an understanding and a description of people's personal experience and phenomenon. It enables the researcher to document the data in a dynamic process (Pruzan, 2016). Holloway and Galvin (2017) suggested that, qualitative research approach involves utilizing a diverse range of data including the spoken and printed word, recorded sound and various media. Holman (2017) went on to say that qualitative research uses small numbers of participants who provide information about their thought and ideas from which some conclusions can be made.

Qualitative research was used because it provides an in depth analysis in the phenomenon in question (King, Horrocks and Brooks, 2018). The qualitative approach was considered more appropriate in providing a better understanding of the research problem. According to Ratiman (2017) qualitative research produces a detailed description of participants, feeling, opinions and experiences and interprets the meaning of their actions. It also simplifies and manages data without destroying the context and complexity (Kowalczyk, 2016). Furthermore, in qualitative research, participants elaborate on a point to give clear meaning. The researcher has chosen this

research approach to get a deep understanding on the teaching and learning of 'O' level Combined Science practical components.

3.3 Research Design

According to Creswell (2015), a research design is a plan or a strategy of investigation conceived with the aim to obtain research questions and also to control variance. King etal (2018) stated that research design is the plan for the collection and analysis of data. It also describes the procedures for conducting the study including when, from, whom and under what condition the data would be obtained. Kothari (2021) defined research design as a detailed outline of how an investigation will take place. In this study, detailed case study was used in order to investigate the teaching and learning of 'O' level Combined Science practical components in a rural environment. As a learning component it was difficult to study many schools because of limited lead time of operation, therefore only two schools were studied so that the best understanding of the phenomenon being studied would be obtained. The schools were, Chinyika high School and Takura Secondary School in Mashonaland East Province, Goromonzi district.

According to King etal (2018) a case study is a qualitative research design best situated for getting an in depth understanding of social phenomenon within the cultural, social and situational context without imposing pre-existing expectations. In addition, Mahajan (2017) defined a case study as a description or history of an event or sequence of events in a real life setting. This type of research design was chosen as it allows observation of participants in a completely natural and unaltered environment. A case study is important in this research because it helps the researcher understand better how to equip the learners.

3.3.1 Case Study

Robson and McCartan (2016) defined a case study as the development of detailed, intensive knowledge about a single case or a small number of related cases. A case study also had considerable ability to generate answers to the question "why?", as well as "what?" and "how?" (Sammut-Bonnici and McGree, 2015). This helped the researcher to solicit solutions to questions such as, what are the challenges faced in the teaching and learning of Combined Science practicals at "O" level? as well as what means and ways can be adopted to improve the teaching

and learning of Combined Science at Secondary School level? It is argued that a well – constructed case study can enable the researcher to challenge an existing theory and also provide sources of new hypothesis (Alvarado, 2017)**.** Finally, the research design led to the selection or sampling of the target population and data collection techniques.

3.4 Population

Mishra and Alok (2017) referred to population of study as the set of all participants that quality for a study, while Ashley (2019) defined population as a total set of observations from which a sample is drawn. In this study, the population measures the aggregate number of subjects that will be incorporated in the study. The total population included all learners and administrators who are teaching and learning Combined Science at Ordinary level from the two selected schools in Mashonaland East province. This population is comprised of 260 (two hundred and sixty) participants as shown in table 3.1. In this case administrators are the school heads, deputy school heads and Science Teachers from the selected schools. These were targeted to give their own opinion on the teaching and learning of 'O' level Combined Science practical components.

Table: 3.1. Population

PARTICIPANTS	TOTAL NUMBER OF PARTICIPANTS	SAMPLE SIZE
Administrators: (teachers, school heads and deputy heads)	10	6
Learners: Cluster A Cluster B	50 200	2 8
Grand Total	**260**	**16**

Source: Ministry of Primary and Secondary education (2022)

3.5 Sample

Kowalczyk (2016) said that a sample is a sub-group or part of a larger population. In other words, a sample is defined as a smaller set of data that a researcher chooses or selects from a

larger population by using a pre-defined selection method (Heale etal, 2015). The use of samples allowed researchers to conduct their studies with more manageable data and in a timely manner. Randomly drawn samples do not have much bias if they are large enough, but achieving such a sample may be expensive and time-consuming. In this study the sample size comprised of ten (10) learners, and six (6) administrators [four (4) teachers and 2 (two) headmasters]

3.6 Sampling Techniques and Procedure

In this study three sampling techniques were used to determine the research participants. The sampling techniques were, simple random sampling, purposive sampling and convenient sampling (Poth, 2020). The two schools were identified as clusters using convenient sampling technique, where simple random sampling was administered to learners currently doing Combined Science at "O" level. The two schools selected represented separate clusters. The researcher then used simple random sampling to select the required participants from each cluster. In this case the researcher designed 50 cards, 48 with **NO** and 2 **YES** from cluster **A**. Learners were instructed to pick the cards from a small basket. Those who picked **YES** were automatically chosen for the sample. The process was repeated in cluster **B**, where 200 cards were designed,192 written **NO** and 8 cards written **YES**. This constitute a total sample of ten (10) participants. In support, Ingwenagu (2016) says that random sampling can be done by pulling names out of a hat or using a computer to generate random numbers.

This procedure enabled all participants an opportunity of participating in the research. In agreement Blackstone (2018), said that random sampling is a sample in which every element in the population has an equal chance of being selected. This means that any participant can be chosen amongst the group. In support, Mahajan (2018) said that simple random sampling is the simplest form of data collection. This means it is easy to use, since there is no use of any basic skills. Patton (2015) also said that since random sampling takes a few from a large population, the ease of forming a sample group out of a larger frame is incredibly easy. It was also used in the research because it is not expensive and not time consuming.

The researcher also used purposive sampling. Purposive sampling is mainly for administrators. Administrators were chosen using purposive sampling in the form of key informants because

they hold information that one might not get from any other person. In other words, these are people who are selected because of a purpose. The purpose is that they have the information that is required for the research and which the researcher cannot get from any other area or location. In this study purposive sampling was used to select four (4) teachers, and two (2) heads of school that constituted six (6) administrators in the sample.

Surbhi (2018) outlined that purposive sampling is a non- probability sampling technique by which the researcher uses their own judgement in order to select sample members. In agreement King (2016) said in purposive sampling the researcher uses his/her judgement about which respondents to choose, and picks those who best meets the purpose of the study. The researcher used the purposive sampling because it enables the selection of data reach sources. Grays Holloway etal (2017) also said the technique enabled the researcher to select the respondents who possessed rich data on teaching strategies used to cater for students with diverse academic backgrounds. Patton (2015) said that purposive sampling is typically used in qualitative research to identify and select the information rich cases for the most proper utilization of available resources. Purposive sampling was employed in this study because it is not expensive and also not time consuming. In agreement, Saunders, Lewis and Thornhill (2019) also said that purposive sampling is one of the most cost- effective and time- effective sampling method available. Rwadziso (2018) also noted that researchers often believe that they can obtain a representative sample by using a sound judgement, which will result in saving time and money. All the key informants were chosen on basis that they have knowledge or content about practical performance of learners doing Combined Science at 'O' level.

On selection of the schools, the researcher used convenient sampling. The researcher had selected two (2) schools out of 45 schools offering Combined Science in Goromonzi district. These had formed the two (2) clusters A and B. Moser (2018) stated that in convenient sampling it is where one includes people who are easy to reach. This means that the researcher will be enabled to collect data quickly since all the participants are at one place. In agreement Patton (2015) also said that most convenience sampling considers the population at hand. This made data collection to be easy and accessible to the researcher. Regoli (2019) also said convenience sampling is an affordable way to gather data during research.

3.7 Research Instruments

A research instrument is a tool used to obtain, measure and analyses data from subjects around the research topic (McMillan, 2015). In other words, research instruments refer to the tools used to collect data which is relevant to the study. In support Alvarado (2017) described research instruments as essential tools to measure such variables as opinion, attitudes, concepts, and compositions. They also suggested that questionnaire and interviews were effective tools when conducting research in education. In this study, the researcher employed questionnaires and interviews in soliciting information from the participants. A detailed discussion of the instruments is given below.

3.7.1 The questionnaire

Questionnaires were administered to the learners. A questionnaire is simply a tool for collecting and recording information about a particular issue of interest (McLeod, 2018). According to Patel and Patel (2019) there are two types of questionnaire which are structured questionnaires or closed ended and open ended questionnaire. Taherdoost (2016) stated that open ended questions are free from survey questions that allow respondents to answer in open text format so that they can answer based on their complete knowledge, feeling and understanding. Structured questionnaires are usually associated with quantitative research which is concerned with numbers. In other words, close ended gives quantifiable data while open ended enables participants to express their views then the data collected cannot be quantifiable (Patton, 2015). In this study open ended questionnaires were used in order to collect qualitative data. According to MacLeod (2019) questionnaires are printed documents that contains instructions and statements that are compiled to obtain answer from respondents. A questionnaire is a chief tool of gathering field data. It is mainly made up of a list of questions (Patel etal, 2019; Patton, 2015 and Grix,2018). In other words, it consists of a series of questions that contains both open and close ended questions.

The researcher used questionnaires because they allow collection of information from a large sample. In agreement Taherdoost (2016) also said potentially information can be collected from a large portion of a group. According to Bryman and Bell (2015) a questionnaire is an essential

instrument for data collection because it allows freedom of expression by the respondent since the researcher will not interfere with feedback from participants. In agreement Patel etal (2019) also said that the questionnaires made it easy for the participants to have the freedom of private response to more personal questions as they were provided with enough time to answer the given questions. This implies that bias was minimized since the researcher did not interfere in the answering of questionnaires. Fear of victimization was cut by participants as they responded to the questionnaire. By so doing confidence was built in the participant who then provide true information honestly. McLeod (2018) summarized the advantages of questionnaires as efficient, less biased, cheaper and fast to administer. However, questionnaires maybe liable to non-response rate less than 100% return (Yakubu,2018). To overcome the problem of non-response and non-return the researcher physically administered the questionnaire by personally distributing, checking on all responses and collecting the questionnaires on completion. The technique of self-administration of questionnaires conforms to Creswell and Creswell (2017) who articulated that the researcher has the opportunity to explain issues that require clarification. The researcher had the opportunity to collect the 100% completed questionnaires.

3.7.2 The interview

The researcher also used Key Informant Interviews (KII) to administrators like teachers and School Heads (McMillan, 2015). An interview is a collection of data that involves oral questioning of respondents either as an individual or a group. According to Pathfinder International (2016), there are 3 types of interviews which are structured or standardized semi structured and unstructured or in depth. Kothari (2021) went on to say, in a structured interview the interviewer asks a set of standard, predetermined questions about particular topics in a specific order. Aelfil and Negida (2017) stated that in a semi structured interview, the interviewer uses a set of predetermined questions and the respondents answer in their own words and in an unstructured interview the interviewer has no specific guidelines, restrictions, predetermined questions or list of options. In this study the researcher used the standardized interview which enabled her to ask the same open ended questions to all interviewees. The researcher did this using face to face conversation. In agreement Pathfinder International (2016)

said that, the face to face interview gives respondents a free environment to respond in their own words. According to Patel etal (2015) an interview is a collection of data that involves oral questioning of respondents either as an individual or a group. Interviews were loosely structured, relying on a list of issues to be discussed (Pathfinder International ,2016). Interview was done face to face.

The advantage for using interview as an instrument was that it allowed the researcher to clarify the questions in the event that the interviewee did not understand (Aelfil etal ,2017)). It also allowed the interviewer to clarify the question in the event that the interviewee did not understand (Creswell and Creswell, 2017). This implies that the respondent could respond in any manner he/she sees comfortable giving his/her views and opinions. This instrument made it possible for the researcher to judge from facial expressions of the interviewee that they were no longer interested or could not understand the question. In support, Kothari (2021) said the researcher could observe verbal and nonverbal behavior of the participants which gave depth insight about the subject in question. Machingura, (2016) asserted that the main advantage of the interview technique is that the interviewer had the flexibility to pursue a point or elaborate and redefine a response if it appeared incomplete and ambiguous. During the interview session, the researcher recorded responses on the interview schedule. This was done to avoid missing important information when recorded later.

However, some authorities argue that data obtained from interviews could be difficult to summarize or evaluate (McMillan, 2015). This problem was minimized by attending seminars and reading wide on research methods scholarly about research.

3.8 Data collection procedure

Data collection refers to all operations related to getting information from participants for answering the research problem (https://ori.hhs.gov>dctopic). The researcher sought for permission to carry out the study from Bindura University of Science Education and the Ministry of Primary and Secondary Education. The researcher pilot tested the interview questions with other learners who were not part of the study sample to assess whether the instrument was appropriate for the study. If not properly done, the instrument may provide wild responses, which do not answer the research questions (Kothari, 2021). As explained by McLeod (2018),

research materials like interview schedules were pilot tested to check whether the technique itself was right for the exercise.

Standardized interview schedules were conducted with the administrators in education. Participants responses were recorded against the questions to establish what they thought were remedies to the teaching and learning of Combined Science practical components (Kothari, 2021). This enabled the researcher to reduce the possibility of distorting the information when writing it up later. The interview questions were carefully constructed to cover all the areas under study. This also ensured that the wording was clear and straightforward (McLeod ,2018). Elaborate steps were taken to ensure anonymity of respondents to interviews to avoid participant bias (Raymond, 2018).

In addition, the objectives of the interview were explained prior to the interview. This was done to remove any suspicions or doubts from the interviewees, which could otherwise prompt them to withhold or give false information (Bans-Akutey and Tiimub, 2021). Questionnaires were distributed to learners and the researcher followed the responses to ensure a 100% response rate. In addition, the researcher monitored this activity from both schools during the learning progress. Learners were given adequate time to respond.

Table 3.2 below shows a summary of the data collection strategy based on the research questions:

Table 3.2: Data Collection Strategy

Research Question	Research Methods
1.**Major research Question:** How is Combined Science practical component being taught at "O" level in rural areas?	Interviews with the administrators at the selected schools. Questionnaires with the learners from the selected schools.
2. **Sub-research question 1**: What instructional materials are available to assist the teaching	Interviews with the key informants in education.

and learning of Combined Science practical component at 'O' level in rural areas.	
3. **Sub-research question 2**: What are the challenges faced in the teaching and learning of Combined Science practicals at "O" level?	Interview with the key informants in education. Questionnaires for the learners
4. **Sub-research question 3**: What tools are required for effective teaching and learning of Combined Science practical component?	Interviews with the key informants in education. Questionnaires with the learners

Adapted from Kwaramba (2015)

Table 3.2 above describes how the researcher utilized the selected research instruments to respond to the research questions. Two data collection methods were settled on because of the need to get diverse experiences and opinions in order to get an understanding of the questions being asked in the study. In support of this statement, Bans-Akutey and Tiimub (2021) defined triangulation as the use of more than one method to the investigation of a research question in order to reduce bias by counteracting some weaknesses of one research technique.

3.9 Credibility

Reducing the possibility of getting the answer wrong means that attention has to be paid to particular emphasis on reliability. Reliability is the ability of a procedure to produce the same result under constant conditions on all occasions (Heale and Twycross, 2015). Korstjens and Moser (2017) asserted that, reliability is concerned with accuracy of data and consistency of instruments when repeated measurements are made. It can be assessed by posing two questions. Firstly, will the measure yield the same result on different occasions and secondly, will similar observations be made by different researchers on different occasions? (Kubai, 2019). All interview schedules and questionnaires will be pilot tested for reliability before administration.

3.10 Trustworthiness

Mohajan (2017) defined validity as the quality of data gathering instrument that enables it to measure what it is supposed to measure. In support, Heale etal (2015) stated that validity of an instrument is very vital in order to produce a successful research project. In other words, validity is concerned with whether the findings are really about what they appear to be. It tells us whether an item measures or describes what it is supposed to measure or describe (Morris and Wood ,2015). Validity of instrument was ensured during designing of instruments through consultation with the supervisor. Interview schedules were matched with the research objectives for validity of the information. The triangulation technique also validated responses provided. The researcher followed up on some responses with field visits to ensure external validity of the results.

3.11 Data Presentation and Analysis

Once the data had been collected from the sample, the next step will be to analyse the data so that the research objectives could be achieved. According to Surbhi (2018), presentation is a process that can be used for data analysis, transferring data from information gathering instruments to tables, bar graphs, line graphs and frequencies. Data from interviews were grouped into themes and analysed qualitatively through text analysis. Descriptive tools were employed to portray and construe the detailed distribution of responses to some questions. Questions from questionnaires that were presented were analysed.

3.12 Summary

This chapter has outlined how the research was carried out. The qualitative research was used in conducting the research. A detailed case study was used in order to investigate the teaching and learning of 'O' level practical components. The population was comprised of 260 participants and the sample size was comprised of ten (10) learners, four (4) Combined Science teachers and two (2) administrators. In this study three sampling techniques were used to determine the research participants. On research instruments, the researcher employed questionnaires and

interviews in soliciting information from the participants. The next chapter dealt with data presentation, analysis of data and discussion of the major results of the study.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.1 Introduction

This chapter presented the results of the study on the teaching and learning of ‘O” level Combined Science practical components. Of interest were the outcomes of improved performance in the learning of Combined Science practical at ordinary level. The data was

collected by means of KIIs and questionnaire techniques. Participants from the selected sample provided the data. However, research findings were presented as guided by the sub- research questions and data sets. The first section of this chapter presented the research findings according to the data collection methods and the emerging themes. The second section discussed the findings as guided by the research questions including descriptions, related literature and analysis of data.

4.2 Research Findings

Key Informant Interviews (KIIs) and questionnaires were conducted in an effort to provide answers to the main research question: "How is Combined Science practical component being taught at Ordinary level in rural areas?" This section presented data collected from KIIs and questionnaires. There were two hundred and fifty learners and ten administrators who were taking combined science at the two selected schools as tabulated in table 3.1 in the previous chapter. Administrators included the teachers for combined science, and heads of schools. The findings were presented according to the instrument administered as presented below:

4.2.1. Key Informants Interviews

The researcher interviewed six (6) key informants representing ten (10) administrators in order to get rich data on the aspects under study and to answer the research questions. The key informants were drawn from various participants that included the teachers, deputy heads and heads of schools. Table 4.1 below gave a description of the interviewees and their codes as used later in the chapter.

Table 4.1: Key Informants

Interviewee Code	Interviewee Description
TR -01	Combined Science Teacher of school 1
TR -02	Combined Science Teacher of school 2

TR- 03	Combined Science Teacher of school 3
HODS	Head of Department - Science
HS-01	Head of School 1
HS-02	Head of School 2

Source: Author (2022)

4.2.1.1 Challenges being faced in the teaching and learning of combined science practical components.

The interview participants provided their views on the challenges being faced in the teaching and learning of practicals in Combined Science at "O" level in Zimbabwe. It emerged that the teaching of Combined Science practical was faced with a lot of challenges with regards to the demands of the new curriculum as well as the modern trends in technology and innovation. The responses were consolidated and the emerging themes on the challenges affecting the preparation of learners for self-reliance when learning Combined Science by administrators were presented below:

4.2.1.1.1 Availability of Resources

Responses from all the participants emphasised on the availability of resources as a critical factor for successful implementation of combined science's new curriculum in education. Administrators revealed that, most teachers made use of old Science text books, broken equipment, hand drawn charts, under equipped science laboratories, large classes, high teacher/pupil ratio, use of unprotected clothing, inadequate practical periods and few laboratory apparatuses readily available. As a result, this have affected leaners' exposure to new technology being used in the world of work. In support, De and Dutta's (2015), Gamawa (2015) and Olayinka (2016)'s studies showed that, a shortage of adequate equipment for practical lessons was revealed as a major challenge facing the teaching and learning of practical work in science subjects. These finding also concurred with Silas etal (2019)'s study which revealed that lack of well-equipped science laboratories and inability of teachers to improvise instructional materials hindered the teaching and learning of science practicals in the Oshana Region in Namibia. These obstacles were also observed in Olayinka (2016)'s study in the teaching and learning of science

practical. The study also revealed that, inadequate instructional materials, lack of improvisation on the side of teachers and utilization of teaching aids, as well as inadequate laboratory constituted problems to the teaching and learning in the science subject.

Responses from the selected schools (TR-01 to 03; HODS and HS- 01 to 02) who were interviewed also highlighted that without financial resources acquiring adequate resources and embracing new technology in school laboratories is not possible. Limited financial capacity may undermine the ability of schools and organisations to acquire and maintain highly automated equipment in order to respond to the turbulent environment (Olayinka,2016). All the administrators interviewed explained the challenges they were facing as a result of unavailability of adequate resources. Gamawa (2015) argued that inadequate funding, especially by government was a challenge facing the practical classes in sciences. Kumoz (2017) further revealed that learners who chose science and technology subjects such as home economic and science were expected to provide necessary equipment on their own with limited support from government. TR-01 had this to say;

> *"…… due to financial constraints, schools are failing to procure modern laboratory apparatus and equipment such as internet facility for research and learning that equip learners with relevant and current knowledge and skills in science education. This prepares the learner for self-reliance and sustainability as they interact with the industry. If equipment is hired, the problem of resource queues will disadvantage learners as they want enough time developing the required skills. Therefore, Government should subsidize the costs of purchasing most useful equipment and materials for sustainable education in all subjects".*

According to TR-02, In the Zimbabwean context, cost was revealed as a barrier in implementing newest technologies to readily equip science laboratories in schools. Import tariffs, high bank rates and profiteering by distributors were also reported by participants as factors that restrict schools from acquiring new textbooks, laboratory equipment and other learning resources since the cost of acquiring and maintaining the equipment was not feasible (TR-01; TR02; HODS and HS-01). Similarly, Donkoh (2016)'s studies in Ghana's rural Africa, argued that schools also lacked funding and social amenities, such as electricity and internet connectivity. Instead, some schools opted to lease equipment and apparatus or improvising most equipment which were usually old and unreliable. HODS indicated that, most schools relied on old broken apparatus which greatly disadvantaged learners in face of modern technology in the science industry. As a

result, this negatively affected the teaching and learning of practical components in the subject area as learners prepare for self-reliance and innovation.

4.2.1.1.2 Top Management Support in schools

Most of the interviewees were generally in agreement that top management support was a key factor to the implementation of Science curriculum in schools. One of the participants (HS-02) said that the champion of any initiative by senior management such as SDA, School Trusts and Ministry of Primary and Secondary Education is key for its success (Donkoh,2016) . HS-01 added that, embracing new technology and innovations is a project that require top management's commitment as they provide the needed support in terms of financial resources, human resources and the knowledge (Deshmane, 2016). Therefore, top management's commitment and support will facilitate the fast adoption of the required laboratory equipment, adequate learning time, new technology and skills for self-reliance in science practicals at secondary school. Silas etal (2019) supported that top management support is critical to the success of the manufacturing strategy. They also argued that, no matter to which strategy, product-centric or service-centric, top management support can help to get necessary resources (facility, capital, IT, and human resource) and then to achieve the benefits of different strategies. In addition, Guz, (2019) noted that the implementation of practical activities in science and technology involves huge outlays which calls for support from financial houses.

Similarly, HODS has this to say:

> *"Lack of Government support in the implementation of science education initiatives have caused negative impact on school development. For instance, the development of modern laboratories and science workrooms in rural schools need a lot of funding from non-governmental organisations like UNCEF through the government of Zimbabwe.".*
>
> *Source: Participant HODS. July 20, 2022*

4.2.1.1.3 Economic Environment

According to the administrators the current economic environment in the country can either promote or hamper the success of the teaching and learning of science practical at secondary schools (HODS, HS-01 and HS-02). All Teachers and Heads of schools interviewed said that, in the current environment in Zimbabwe, it is very difficult to acquire better equipment for the subject given that most of the modern equipment and chemicals are imported and there is limited customer support available locally. In support, Ngman-Wara, (2015) argued that some of the schools were also too small to justify mobilization of funds required for the subject's modern requirements given their poor environment in the rural areas.

HS-01 indicated that, most schools do not have proper Science workshops or laboratories to carry out their practical lessons as these are done in ordinary classrooms. All teachers revealed that, absence of credit lines and unfavourable short term borrowing conditions (e.g. high interest rates) have not only created working capital challenges but hampering the possible boost in the science and technology sector (recovery process) and curriculum implementation (TR-01; TR-02; and TR-03). The research findings also indicated that, slow economic recovery from the global crunch still has an adverse bearing in the demand of teaching and learning of the subject. This also forced many teachers to leave the profession in search of greener pastures in the diaspora. Research also showed that, the last decade has witnessed institutions of learning in Zimbabwe losing large numbers of key professionals because of a brain drain (Mushonga, 2015).

All interviewees unanimously agreed that the impact of the current COVID 19 pandemic have a negative bearing on the successful implementation of the practical components in Science education as most lessons were being done virtually. Hodges, Moore, Lockee, Trust, and Bond (2020) noted that, the coronavirus pandemic has upended the world's education system, as most schools in every country have closed their doors for extended period to combat the spread of the virus.

4.2.1.1.4. Resistance to Change and Inertia

It emerged in the interviews that while most other industries have undergone tremendous changes over the last few decades, and have reaped the benefits of process and product innovations, Science education in secondary schools especially in the rural areas have been hesitant about fully embracing the latest technological opportunities in modernising their laboratories if ever it existed (Mupinga,2015). Some participants (TR-02, HOD and HS-01)

indicated that slow migration (inertia) from traditional processes (hanging to old technology) to automated processes is one factor that impede the teaching and learning of Science practical component as learners are slow to grasp new technology for self-reliance. Literature review acknowledged that, experts always feel responsible for upholding earlier standards, as they have sometimes been part of creating them and promoting their benefits (Bialik and Fadel ,2017). Being loyal to their field of study, they also find it difficult to discard parts of the whole cloth of their field's knowledge, even as those parts become less useful (Robinson and Aronica,2015). HS-02 and TR-03 added that, resisting change and continuously referring to old ways of doing business such as banking methods, lecture method and demonstrations, also affects the teaching methodologies being employed by the educators during the practical sessions. HS-01 commented that, *"It's no secret that people like routine activities. It's comfortable, as it gives people direction and requires minimal thought. This can make it challenging to get learners embrace the new curriculum which is encouraging the use of new technology and innovation, but it doesn't have to be that way as change has to be embraced and not challenged''*

4.2.1.2 Relevant Skills and Experience for Science Teachers

The research revealed that Combined Science at secondary school is lagging behind in embracing new innovative skills for improved performance. This was shown by the qualifications, experience and teaching methods as well as the available equipment being utilized by the teachers in teaching Science practical components in Zimbabwe. Literature revealed that, the quality of teaching staff was a major determinant to the quality of graduates the schools produced and their eventual impact on the world of work and economic development (Mushonga, 2015). It added that, there was generally shortage of experienced and qualified teachers in Zimbabwean schools for the practical subjects (Chimhenga ,2015). The following emerging themes came out as challenges of skills and experiences for Science teachers as they implement the curriculum at secondary schools in Zimbabwe, after participants were asked how skilled were the teachers for teaching Combined Science practical components at 'O' level.

4.2.1.2.1 Lack of Skilled Human Capital

All interviewees indicated that most Combined Science teachers in schools lack prerequisite skills and qualifications to use modern technology and initiatives in terms of the modern teaching methods and equipment in the subject area. In support Quansah etal, (2019) argued that, most schools that offer science subjects in rural communities lacked qualified staff. They added that, the shortage has led to the use of unqualified teachers which perpetuates the vicious circle of poor teachers producing students who do not meet the standards required in the world of work. The following findings on qualifications were reviewed on table 4.2 below:

Table 4.2: Qualifications for Teachers and Administrators

Participants	Qualifications
HS-01	Degree in Education
HS-02	Degree in Education
DODS	Diploma in Education
TR-01	Diploma in Education
TR-02	Diploma in Education
TR-03	Diploma in education

Source: Author (2022)

The qualifications shown in table 4.2 above revealed that, there is still need for capacity building to equip the teachers with relevant knowledge in the teaching and learning of the new requirements of the science curriculum which calls for embracing the new technology and innovation. Therefore, without the necessary fiscal and human resources it is difficult to achieve the requirements of the Science curriculum. Muza (2020) argued that in service training programs make teachers equipped with logical systematic approaches to apply in classes. Junejo etal (2017) also added that, in service training programs make teachers equipped with logical and systematic approaches to apply in classes. These sentiments were also echoed by the HS-01 who indicated that for any change to succeed, there is need for well skilled and motivated staff. They added that, the brain drain of labour from the country to greener pastures in the last decade has aggravated the labour market in Zimbabwe and the education sector is not an exception. In support Mushonga (2015) said that, in Zimbabwean schools, many teachers have left the

teaching profession to escape the worsening economic situation with hyperinflation having turned their salaries into pittances.

4.2.1.2.2 Lack of Experienced Human Capital

Teachers echoed that lack of experienced human capital resulted in the science and technology industry as a whole including schools leaning on old methods and archaic styles that have been proven to be successful but may choke innovative motives. In support of this view, Rogan and Grayson (2015) stipulate that, teachers' capacity is a critical factor if quality results are to be realized in schools. The following experiences were revealed during the interview:

Table 4.3: Experience of Teachers and Administrators

Participants	Experience
HS-01	16 years
HS-02	12 years
HODS	8 years
TR-01	2 years
TR-02	5years
TR-03	3years

Source: Author (2022)

4.2.1.3 Instructional materials being utilized in teaching of combined Science

The participants were asked to give their views on the instructional materials being used in teaching of Combined Science practical lessons at secondary school. It came out from the participants that most schools used textbooks, charts, posters, few scientific apparatus, improvised materials such as empty containers, coal pot, cooking pots, spoons, plastic plates, napkins, tissue paper**,** burners, models and no use of e-learning software or virtual laboratories (TR-01; TR-02; HODS; HS-01 and HS-02). Instructional materials are the tools used in educational lessons, which includes active learning and assessment (Ajoke,2017). Basically, any resource a teacher uses to help him/her teach his students is an instructional material (Botes,2021). Abdu-Raheem and Oluwagbohunmi (2015) pointed out that, instructional materials can include manipulative items for in-class lessons such as protractors, safety goggles,

T-squares, blocks, chalk, models, pencils, rulers and art supplies. Participants expressed that: TR-01*: I use charts, and models, to allow the students to identify the different parts they have to master*. *I also use improvised materials such as empty peanut butter and shoe polish containers to cover up for the shortage of required apparatus*. HODS added that:

> *A few schools in urban and boarding areas have facilities for new technology such as e-learning software; hence, they show videos of topics they will be teaching. Not all schools have e- learning software, most schools use textbooks, handmade charts, posters, few scientific apparatus (stop clock, weighing balance, beakers, funnel, flask, and sodium chloride) and improvised materials.*

4.2.1.4 Workshops and Continuous Training

Participants were asked whether they attend subject related workshops and training. All participants agreed that there were no subject related workshops being done in their areas due to resource constraints (TR-01; TR-02; TR-03; HODS; HS-01 and HS-02). However, very few teachers are being trained through the current government initiative training (Teacher Capacity Development). The responses given are as follows: HS-01: *There are no staff development initiatives currently due to the poor economic environment***.**TR-02 added that, *a few teachers are training through UNCEF initiative.* Davis (2015) responded that, professional development for teachers can help them to plan their time better and stay organized which lead them to be more efficient and gives them extra time to focus not on paper work but students. In support Newase etal, (2017) added that, workshops are a good opportunity to learn new skills and familiarise with certain topics which one do not know well.

4.2.1.5 Tools and Equipment for effective teaching of Combined Science practical.

The question aimed to establish the views of the teachers and administrators on what they thought need to be done in order to address the challenges they were facing and preventing them from carrying out practical work in Combined Science. TR-02 suggested that all the materials

specified by the subject syllabus needed to be purchased and available at the beginning of every academic year. HS-01 also added that the people responsible for drawing the academic calendar and scheme of works should ensure that certain topics with practical works that might be affected by weather are allocated within the right time of the year. Kahu, & Nelson, (2017) suggested that the use of instructional materials facilitates learning processes as they bring the real meaning of what is being taught to light. Meanwhile, Abu-Raheem (2016) added that, for more effective results any instructional materials that lecturers choose as enhancement for their teaching should be suitable and relevant to the teaching strategy and learning packages.

HODS suggested that capacity building workshops on how to improve practical works in combined science should be organized regularly for the teachers. TR-01 added that schools should be provided with well-equipped practical laboratories. HS-02 stated that the teachers need to be trained on how to carryout practical work. According to Kola and Langenhoven (2015), workshops introduces new ideas and inspire participants to further explore on their own. This means one can be able to improve his or her work and attitude (Mwangu, and Sibanda, 2017). The responses were consolidated and the emerging themes on the tools and equipment that may be used by schools offering combined science for effective teaching and learning in Zimbabwe rural schools were presented below:

4.2.1.5.1. Continuous Training

It emerged from the interviews that training is critical to the adoption of the curriculum. Teachers revealed that, it is imperative for teachers to go through in-service training or capacity development programs so as to keep abreast with modern technology in science and technology. According to Bruns (2017) teacher development is important for any organization as well as for any country that holds the targets of improvement in their capacity building. Quansah etal (2019) noted that in service training programs make teachers equipped with logical systematic approaches to apply in classes. Participants also added that, teachers should continuously attend subject related workshops and seminars especially on the new curriculum for effective teaching of practical components. Sharing the same point HS-02 added that, there was need to have more

field trips so that learners familiarize with dynamic technology in industry. In support HS-01 said training also motivates teachers to like the subject and in return benefit the leaners.

4.2.1.5.2. Infrastructure for effective learning

Participants interviewed revealed that government should also assist schools by constructing science workshops, laboratories and helping in purchasing modern machinery and equipment for effective learning. They added that schools should also embrace new technology, innovation and internet of things in the teaching and learning of science practical components to overcome challenges being posed by the COVID 19 pandemic (HODS; HS-01 and HS-02). In line with this, Newase etal (2017) suggested that the use of ICT fasten both practical and theoretical teaching and learning of science and technology, for example use of iPhones, iPads, you -tube and internet of things. Teachers also said that there is need for computers loaded with appropriate software to help in the teaching of the subject. Abu-Raheem (2016) concluded that the utilization of ICT has many benefits which include multiple sensory deliveries, increased self-expression and active learning.

4.2.1.5.3. Use of Resource Persons

The research findings revealed that, there are always people who readily accept new innovations, and these are the leaders in new initiatives. Salim (2015) argued that, these leaders can help convince reluctant people where no one else can. HS-01 suggested that, schools should engage subject specialists and experts in industry to help in skills acquisition to learners. HODS added that, well trained and equipped resource persons should be allowed to assess students' competencies in practical work when conducting science lessons. In support Komalafe (2016) concluded that, inviting an expert to your classroom or visiting one in their workplace can serve several purposes. Using experts can help students to make connections between their learning and the real world **(**www,theeducatorsroom.com).

4.2.1.5.4. Eliminate Negative Attitude

During the interview with administrators in schools, most of the participants suggested that some people are inclined to express negativity towards any change, usually out of fear and

stubbornness. They added that, tolerating any negativity will only permit the negativity to continue and risk it influencing other learners at the school. TR-01 advised that, schools should nip it in the bud and firmly communicate that only positive attitudes are acceptable. This will reduce or minimize negative influence towards practicals as it may require manual labour. Students with negative attitudes in the classroom can create an unpleasant environment for teachers and peers (Villamor and Bulat-ag, 2017). Jagodilla and Bulat-ag (2017) concluded that, there is need to learn the causes of negative attitudes and explore strategies for teachers and partners to turn these attitudes around.

4.2.1.5.5. Field Trips and Project based Approach

The participants were asked about the methods that they could use in teaching Combined Science practical lessons. They revealed that Combined Science teachers should explore the use of both teacher-centred and student-centred methods during practical lessons. It was shown from the responses that both schools only used demonstration methods in teaching practical lessons. Kelly (2019) went on to say educational field trips give students the opportunity to have first-hand experiences and explore the world. Whilst, Whitesell (2015) argued that field trips enrich, vitalize and compliment content areas of the curriculum by means of first hand observation and direct experience outside the classroom. Their remarks are cited below: TR-02*: I will answer in two ways, teacher centred approach and the chalk and talk approach. This ensures that one spends less time and more content of syllabus is covered on allocated time.* TR-03*: Students are put into groups which allows working with resources that we have. I also integrate them according to their different strengths. I also make sure that all are involved in the practical lesson activities.* HODS*: Mostly, teachers do demonstration, but rarely find students doing practical lessons on their own. It is therefore important for teachers to explore the use of field trips, project based approach and science exhibitions to enhance learners with the required skills in science education.* TR-03*: Teachers should use hands on approach to help students understand better. It is because of that philosophy "when I hear I forget and when I do I remember".* Umugiraneza etal, (2018) concluded that, project based learning makes learners to have a better understanding of the topic.

4.2.2. Questionnaire with the Learners

In an attempt to unearth the challenges being faced in the teaching and learning of the practical components in Combined Science at 'O' Level in Zimbabwe's rural schools, the researcher also administered questionnaires to ten (10) participants in order to get more information on the subject under study. Questionnaires were distributed to ten 'O' level school learners out of a population of two hundred and fifty learners. Out of the ten participants a 100% response return was achieved. This instrument equipped the researcher with a variety of tools and techniques which were used by leaners in learning Combined Science practicals at school. It also helped the researcher suggest the easy at which work can be executed by learners through the use of modern teaching methods and equipment. McLeod (2018) summarized the advantages of questionnaires as efficient, less biased, cheaper and fast to administer. The findings of the research were described below:

4.2.2.1. Challenges being faced in learning Combined Science practical

The findings from questionnaires were consolidated on the challenges affecting the teaching and learning of Combined Science practical by learners. It was revealed that, there are a lot of challenges affecting the preparation of learners for self-reliance at secondary school level. These challenges included the following: shortage of learning materials; lack of funding to purchase learning materials; no workshop rooms for learning practicals; inadequate time allocated for practicals; lack of trained and motivated facilitators; obsolete equipment, under-developed infrastructure, use of old teaching methods, use of unprotected clothing, large classes, and little or no internet connectivity (TR-01; TR-02; HODS; HS-02 and HS-02). Silas etal (2019) had observed similar challenges in the Oshana region, Namibia, which are mainly associated with curriculum implementation namely, the lack of equipment, insufficient timetable time for practical work, lack of safety precautions in the laboratory and learners' participations, large number of students, none availability of resources, and the absence of trained laboratory assistance.

Participants also revealed that the use of field trips and industry expert are not well utilized in the teaching of Combined Science practicals. Responses from questionnaires also showed that the need for leveraging new technology and innovation in the subject area for easy of doing work is not yet being embraced by most schools teaching practical subjects. Donkoh (2016) added that,

lack good buildings, funding and social amenities, such as electricity and internet connectivity are a cause of concern in rural schools, Thus, the stakeholders in education must ensure that resources and adequate funding are availed in order to adequately prepare learners for the world of work.

4.2.2.2. Time allocation

In response to the question pertaining to time allocation for Combined Science practical lessons, all participants mentioned that they teach six periods per week. Most of the participants said that they allocate two periods per week for Combined Science practical lessons. The participants were further asked if the allocated time was enough and they all agreed that the time allocated was not enough due to large classes. Bello (2015) encouraged schools to equip learners with relevant skills by providing enough practical time. It was also revealed that practical sessions are allocated thirty-five (35) minutes each (Science Practical Manual, 2018).

4.2.2.3. Tools and Equipment for effective learning of Combined Science practicals.

The responses from questionnaires showed that there are a variety of tools and equipment that can be utilized in schools for effective learning of the subject. Responses from participants are presented in Table 4.4 below:

Table 4.4: Responses on the tools and equipment for effective learning of Combined Science practical

Item	Main Findings
1.	Learners should be involved in choosing the subject
2.	Schools to prioritise Combined Science needs especially practical requirements
3.	Government to provide refresher workshops or seminars for teachers
4.	Construction of modern laboratories
5.	Adequate allocation of learning time for practicals
6.	Hire competent and skilled personnel
7.	Provide field trips, natural trips and project based methods
8.	Well trained and equipped resource persons

Source: Author (2022)

They also revealed that the need of internet of things is also crucial in the teaching and learning of the subject. The learners stated that for an improved performance in the subject area, learners should be given the opportunity to interact with the world of work before leaving school in order to be well prepared for industry operations. Newase etal (2017 agreed that, learners should move with technology. The teaching and learning of Science education involves various skills and techniques hence the need to apply information communication and technology to enhance effectiveness in the study (Abu-Raheem, 2016). This may be done through, field trips or engaging the champions of industry to educate the learners.

4.3 Discussion of Research Results

While some schools have introduced Combined Science in their curriculum, there were a lot of challenges being faced in implementing the objectives of its practical components at ordinary level in Zimbabwe (Ta,2018). A case study in Ghana done by Joana etal (2015) stated that one major objective of Ghana's educational system is to equip individuals with employable skills to enable them contribute meaningfully towards the development of the nation. Joana et al (2015)

also noted that practical teaching hours in Science education syllabus is not adequately provided for and should be increased. This mediocre track record was attributed to various internal and external challenges. The challenges were, shortage of learning materials, lack of funding to purchase learning materials, trained and motivated facilitators; obsolete equipment, under-developed infrastructure, use of old teaching methods, unprotected clothing, and large classes (Silas, Abah and Mashebe ,2019). Participants also revealed that the use of field trips and industry expert are not well utilized in the teaching of Combined Science practicals. This section discussed research findings in line with the sub- research questions under study.

4.3.1 Sub- Research Question 1

What are the challenges pupils and teachers face with the teaching and learning of Combined Science practical components at "O" level in rural secondary schools?

It emerged from the findings that indeed Zimbabwe's secondary schools were lagging behind in embracing new innovative technologies for improved performance for self-reliance and sustainability (Gamawa ,2015). This was revealed through questionnaires that some schools were still applying the traditional methods in the teaching and learning of combined science practicals such as teacher centred approaches, use of obsolete equipment and old techniques that failed to equip learners with the relevant skills for the world of work. The participants' responses suggested that there were some secondary schools in Mashonaland East Province that did not have instruments for conducting practical works.

Without the necessary equipment and apparatus, teachers might not allow learners to do practical works and handle the apparatus on themselves but may rather demonstrate to learners or teach only the theory component of the topic (Mcleod,2017). This might prevent teachers from carrying out all the practical works stipulated in the syllabus, which in turn would disadvantage the learners in the Practical component examination paper (Silas etal, 2019). This is against Daivid Kolb's experiential learning theory which proposes that, learners need to be actively involved in the experiments and reflect on the experiments for them to gain knowledge from it and be able to apply what they learned in the real world (Mcleod,2017). The Key Informant Interviews (KIIs) also revealed that the commonly used tools and techniques such as banking methods, obsolete text books, improvised apparatus, hand drawn charts, and few equipment readily available are not in pace with the turbulent environment.

Research findings also revealed that, lack of adequate resources, lack of top management support, unstable economic environment, and resistant to change by subject implementers were key challenges to the implementation of Combined Science practicals as learners were failing to be employable or being entrepreneurs post-secondary school level (Mupinga etal,2015). This showed that the practical components failed to produce the wholesome individuals to suit well in industry or the next level. These challenges were in line with Silas, etal (2019)'s observations where they argued that some challenges in the Oshana region, which were mainly associated with curriculum implementation were namely, the lack of equipment, insufficient timetable time for practical work, lack of safety precautions in the laboratory and learners' participations, large classes, none availability of resources, and the absence of trained laboratory assistance. Said (2015), identified the top barriers to effective delivery of practical work to include: time constraint due to length of curriculum, lack of necessary equipment and materials, insufficient technical support, lack of students' interest and attitude, lack of teachers' experience in practical delivery, assessment and tests required.

The research findings were consistent with the findings by Donko (2016) as he emphasized that education should equip pupils with skills and mechanisms in order to suit a constantly changing environment. This showed that learners should be taught according to the changing environment in order for them to suit in the society. According to Deshmane, (2016), the 'harsh' conditions in rural communities in general made teachers refuse postings to such places or seek transfer to urban areas. As a result, so many schools in rural communities were under staffed and this had no exception for Zimbabwean schools.

It also emerged from the interviews that most Combined Science teachers in schools lacked prerequisite skills and qualifications to use new initiatives in terms of interactive methodologies that equip learners with the necessary skills. This was shown by their qualifications, experience and teaching methods as well as the available equipment being utilized by the teachers in teaching the practical components in Zimbabwe (Mupinga etal,2015). Most teachers interviewed had diplomas in education which might not enable them to teach new innovations or technology to learners. This called for in-service of teachers to be well equipped to impart the required skills and techniques to the learners for self-reliance (Manwa,2018).

In support, Foster et al (2017) stated that teachers should be competent enough to enable them teach the right skills to students. This means that they should have enough knowledge to impart right skills to the learners. Teacher's capability influenced student's learning outcomes. Rogan and Grayson (2015) also said that teacher's years of experience and quality of training is correlated with the children's practical achievements. Sharing the same idea Zenda (2020) also noted that teacher competencies in the teaching and learning of practical components can be measured by the ability to impart knowledge and practical skills to students. This shows that proper skills, qualifications and experience were required by teachers to enable them teach Combined Science practical components in preparing learners for the turbulent environment.

4.3.2 Sub-Research Question 2

What instructional materials are available to assist the teaching and learning of Combined Science practical components at 'O' level in rural areas.

It also emerged from the findings that indeed the importance of instructional materials in teaching and learning cannot be underestimated. A lot has been revealed by the participants to show the indispensable role of materials in curricular implementation. Ofodu and Oso, (2015) suggested that, Instructional materials make learning more interesting, practical, realistic and appealing. Abdu-Raheem and Oluwagbohunmi (2015) also pointed out that, instructional materials can include manipulative items for in-class lessons such as protractors, safety goggles, T-squares, blocks, chalk, models, pencils, rulers and art supplies. It also came out from the participants that most schools use textbooks, charts, posters, few scientific apparatus, improvised materials such as empty containers, coal pot, cooking pots, spoons, plastic plates, napkins, tissue paper**,** burners, and models. Findings highlighted that most schools do not use e-learning software or virtual laboratories as they are not yet electrified. It is further argued that, these instructional materials also enable both the teachers and students to participate actively and effectively in lesson sessions (Okori and Jerry, 2017).

In support, Ajoke (2017) observed that teaching aids are important for practical and demonstration in the class situation by students and teachers. Abu-Raheem (2016) saw instructional materials as devices that assist the teacher to present a lesson to the learners in a logical manner. In their own perspective, Salazar and Larenas (2018) saw instructional materials

as visual and audio-visual aids, concrete or non-concrete, used by teachers to improve the quality of teaching and learning activities. In addition, Abdu-Raheem (2016) asserted that non-availability and inadequacy of instructional materials are major causes of ineffectiveness of the school system and poor performance of students in schools. Participants recommended that both the students, teachers, parents, Parents/Teacher Association, government and philanthropists should be involved in improvising instructional materials for the teaching and learning in schools. Therefore, Abu-Raheem (2016) advocated for teachers' resourcefulness and also encouraged them to search for necessary instructional materials through local means to supplement or replace the standard ones. By fully utilizing these resources, you, as a teacher or a learning facilitator, can make your lessons rich and fun for your students.

4.3.3 Sub-Research Question 3

What tools and techniques are required for effective teaching of Combined Science practical components?

The study captured and analysed actions on how to improve the teaching and learning of Combined Science practical components in Zimbabwe. These are highlighted in the following sections.

4.3.3.1 Continuous Training

Training is critical to the teaching and learning of Combined Science practicals. It emerged from the interviews that training is critical to the adoption of the new initiatives in Combined Science. Osamwonyi (2016) claimed that further training of lecturers is necessary in order to meet the ever complex student diversity entering higher education institutions and the ever increasing industrial demands. Meanwhile research findings revealed that, it is imperative for teachers to go through in-service training or capacity development programs so as to keep abreast with modern technology in science and technology (The Herald,2020). According to Junejo etal (2017), teachers should continuously attend subject related workshops and field trips especially on the new curriculum for effective teaching of practical components. Donkoh (2016) noted that teachers are regarded as the hub of educational development, therefore in - service education is concerned with the activities and courses in which a serving teacher may participate for the

purpose of upgrading his professional skills, knowledge and interest. Quansah etal (2019) concurred that the government should ensure that teachers who teaches practical components are adequately in-serviced, staff developed and assisted to obtain the highest qualifications and skills possible in the field so that they can be able to impart these skills to learners. In support Foster (2017) stated that teachers should be competent enough to enable them to teach the right skills to their learners. In a case study carried out by Junejo etal (2017) in Karachi Region it was noted that in service training is a long term investment to develop skills and professionalism of teachers. Therefore, it is crystal clear that in-service training, capacity building, subject related workshops or seminars and team building activities are key for the teaching and learning of combined science at secondary school level. Kasiyo, Demuga, and Mukwambo (2017), in their study suggested that the Ministry of Education should bring more training through workshops to equip teachers with more knowledge on how to use practical teaching strategies. By doing so, the Ministry of Education will build a good foundation in Science teaching at secondary school level in Mashonaland East Region.

4.3.3.2 Field Trips

The research findings revealed that, Combined Science teachers should explore the use of both teacher-centred and student-centred methods during practical lessons. It was shown from the responses that both schools only used demonstration methods in teaching practical lessons (Chimhenga,2015). It was therefore important for every school to leverage on new initiatives in order to improve students' performance. According to Berer (2016), field trip is a journey taken by a group of people to a place away from their usual environment. In support, Fink (2020), said that going on a field trip is a wonderful way to extend a learning experience, in such a way that the students not only understand the concept, but also understand how it connects to their world. Reeves & Rodrique (2016) noted that, field trips are vital for students to have a chance to view and explore historical places and different social institutions. Reeves and Rodrique (2016) went on to say, field trips provide an opportunity for the students to view a new place, meet new people, seeing and understanding the things. For example, in Combined Science, when learners visit factories they will see the actual laboratories and factories in real time and learn how they work practically.

4.3.3.3 Use Resource Persons

The research findings revealed that, there are people who readily accept new innovations, and these are the leaders in innovative technology (Kahu, and Nelson, 2017). These leaders could help convince reluctant teachers and learners where no one else can. Findings from interviewees revealed that, schools should engage subject specialists and experts in industry to help in skills acquisition to learners. This should convince learners and encourage them on the need for learning practical components in Combined Science for self-reliance. Literature seemed to support strategic partnerships with Salim (2015) saying ,find a good partner fit for your organization and partner with it or fund it. Komolafe (2016) added that, to make use of strategic partnerships, literature suggest finding a small company or individuals with the expertise that is most likely to help you and engage it. This entail the need of field trips and industry experts in teaching Combined Science practicals to learners as they learn how to use the readily available tools and equipment being utilised in the industry before they join the world of work.

4.3.3.4 Infrastructure for effective learning

Findings from Interviews revealed that government should assist schools by constructing modern science workshops or workrooms that match the laboratories in the health sector. The study findings also revealed that government should help in facilitating the purchasing of modern tools and equipment, chemicals, apparatus and protective equipment for effective learning (Omondi, Imo and Andotima,2016). It also emerged that schools should embrace the new technology, innovation, teaching methods and internet of things in the teaching and learning of Combined Science practical components (Barrett, Treves, Shmis, Ambasz, & Ustinov a, 2019). Workshops are a good opportunity to learn new skills and familiarise with certain topics which one do not know well. Goksoy (2016) noted that workshops provide a way to create an intensive educational experience in a short amount of time. It is a great way to teach hands on skills because it offers participants a chance to try new methods and fail in a safe situation (Zhang & Barrett. 2020; World Health Organization. 2015).

It also emerged in the questionnaires that, in cluster A there was a laboratory dedicated for conducting practical work in Combined Science but the laboratory was not in good condition. Thus, most of the time, the teachers performed practical activities in classroom and do not make use of the laboratory. In cluster B the learners stated that there was a laboratory, but since the laboratory was not in good conditions, they carried out practical works in the classroom or outside depending on the type of experiment. This showed that there are challenges of working space in terms of the availability of the Science laboratory at the two schools studied. As noted by Kasiyo et al. (2017), the lack of science laboratories in schools was a serious blow since some activities could not be conducted in class for the safety of the learners and for the safety of apparatus. Availability of physical resources (e.g. laboratories, science apparatus or portable laboratory stations) was a challenge that prevented teachers from conducting practical works (Barrett, Treves, Shmis, Ambasz, and Ustinova, 2019).

Therefore, learners and teachers in schools should also have skills on the use of the new automated devices to encourage effective teaching and learning (Barrett etal, 2019). This actually means that teachers who do not have enough knowledge on technology had to upgrade themselves in order to be able to impart the skills to the learners. In a case study carried out by Omondi etal (2016) in Kenya, state that many institutions in the country have turned to educate their students on new technology and new initiatives to help develop and produce complex parts quickly and efficiently needed in the external market. This is what the curriculum is after in the teaching and learning of practical components in the Zimbabwean schools (Combined Science Teachers Guide, 2015-2022, Zimbabwe).

4.3.3.5 Eliminate Negative Attitude

The study findings revealed that some people are inclined to express negativity towards any change, usually out of fear and stubbornness (Sethi, 2015). They added that, tolerating any negativity will only permit the negativity to continue and risk it influencing other learners at the school (Zenda, 2018). Therefore, it is important to communicate good comments on good work done by the learners in order to motivate and cultivate positive behavior. On the other hand, it is also crucial to discourage negative behavior by punishing for bad attitude by learners. This will reduce or minimize negative influence towards practicals as it may require psychomotor skills. A

myriad of factors had been seen to have an impact on student's performance. Among these, Singh (2020) has found lecturer and student attitudes to be the most outstanding factors. Lecturers 'attitudes can both enhance students 'academic achievement or can be detrimental to students 'achievement as well Singh ,2020). As stated by Zuma, (2015) a desired educational outcome may not occur due to the attitude one may be bearing. Attitudes play a major role in the success or failure of the delivery of any curriculum in education. If people involved in the delivery of a particular programme have a negative attitude, it is most likely that the programme will not succeed. However, it is worth noting that the word ―attitude often has a negative undertone.

4.3.3.6 Project based learning

Findings from the study revealed that project based learning prepares learners for the workplace, increase motivation and connect learning at school with reality (Kola etal,2015). It also emerged that project based learning provide opportunities to contribute to school or community, increased self-esteem and allowing children to use their individual learning strengths and diverse approaches to learning and providing a practical, real-world way to learning (Umigiraneza,2018). In other words, project based learning encourages active participation, acquiring of skills and creativity to learners.

In a case study carried out by Caper Silverman and Jelenewicz (2017) in USA it was noted that various educators have recommended problem-based learning to provide students with guided experiences in learning through solving complex, real world problems. Komolafe (2016) stated that project based learning is a teaching approach that engages students in sustainable collaborative real world investigations. In support, Bansilal, (2015) stated that traditional learning in classroom based education is being challenged by the ever increasing complexity in our lives, technology advancement and societies. This means that in teaching and learning of practicals most teachers should prefer project based learning which has got more hands on when learning through attaching learners to the real world of work. Kola etal (2015) supported this by saying project based learning prepares students to solve the real world problems. This means that learners will become more creativity through project based learning.

4.4 Chapter Summary

This chapter focused on presentation of research results, analysis as well as interpretation and discussion of research findings. In order to fill the knowledge gap left by previous studies on the teaching and learning of combined science in Zimbabwe's rural areas, it was decided to undertake this study on teaching and learning of Combined Science practical components. This chapter presented the results obtained from the study of teaching and learning of Combined Science practical components in Zimbabwe. The results from the literature review, KIIs, questionnaires as well as data analysis were presented in various illustrations. The research findings were collaborated with various findings from other authors during the discussion. The next chapter presented the summary, conclusions and recommendations to the study.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter summarized the major highlights of the study. The research sought to find ways for effective teaching and learning of Combined Science practical components at 'O' level in rural area, Zimbabwe. It also revealed the challenges being faced by schools in teaching and learning of the subject practical component in the turbulent environment. The chapter was divided into four sections, the first section summarized the major findings of the study taking into consideration the research questions of the study. The second section drew conclusions based on the findings of the study. The third section offered recommendations based on the major findings. The fourth section suggested areas for future research.

5.2 Summary of the findings

This section summarized the major findings in line with the research questions of the study. The major focus of the study was to find the challenges being faced in the teaching and learning of the practical components in Combined Science at 'O' level in Zimbabwe. It further aimed at establishing how the practical component could prepare learners for self-reliance. Skills and competencies of Combined Science teachers were also interrogated in the study. The study finally revealed the tools and ways for effective learning and teaching of Combined Science practical components at secondary school. It was learnt that there are a number of challenges being faced by learners, teachers and administrators in learning and teaching of Combined Science practical. The challenges being faced included, lack of resources, negative attitudes towards the programme by stakeholders in education, unexperienced teachers, unqualified teachers, lack of well-equipped functional laboratories, lack of defined practical lesson's time slot on the lessons' timetable, and inertia. The results of the research showed that the implementation of combined science was exacerbated by learners' negative-attitude and laziness on leveraging new technology and innovation. This study noted that most schools used textbooks, charts, posters, few scientific apparatus, improvised materials such as empty containers, coal pot, cooking pots, spoons, plastic plates, napkins, tissue paper**,** burners, and models for the teaching and learning of science practical in rural secondary schools. It was also noted that both schools studied were not making use of e-learning software or virtual laboratories as there were network connectivity issues. They expressed critical shortage of resources and

negative attitudes of learners towards science practicals in schools. Some interesting findings from the empirical research were summarized as per the sub-research questions below;

5.2.1. Sub- Research Question 1

What instructional materials are available to assist the teaching and learning of Combined Science practical components at 'O' level in rural areas.

There seemed to be no adequate instructional materials to support teaching and learning of Combined science practicals. Teachers bemoaned that school learners who graduated from science at secondary schools lacked the fundamental hands- on skills necessary for them to fit into the world of work. Most of the learners failed practical components due to lack of adequate instructional resources. The study expressed concern on the type of instructional materials being employed by teachers as they used old, outdated and poorly improvised equipment in their laboratories or science workrooms. This would result in learners not acquiring the required skill for self-reliance in the turbulent environment.

It emerged from the findings that indeed Zimbabwe's secondary schools were lagging behind in embracing new innovative technologies during science practical sessions for improved performance, self-reliance and sustainability. School administrators were appealing to the government and the community to take into cognizance the suggestions and partnerships they are given by the captains of industry so as to improve the delivery of Combined Science for self-reliance and self-sustenance. It further revealed that, the partnership between industry and schools was weak and the Government should address this as a matter of urgency. There was a variation on what schools were using as instructional materials and what industry was expecting as there were challenges in acquiring the best apparatus and chemicals for science practicals in Zimbabwean secondary schools.

5.2.2 Sub-Research Question 2

What are the challenges pupils and teachers face with the teaching and learning of Combined Science practical components at "O" level in rural secondary schools?

The study established that the delivery of Combined Science had been marred by a lot of problems, thus making it impossible for quality education to be achieved in secondary schools. This study unveiled that competency is an essential teacher attribute in the delivery of Combined Science curriculum at secondary school level. All the teachers who constituted the sample study had the minimum required qualification that is the diploma in education that enable them to teach at secondary school in Zimbabwe. However, although the teachers had the required minimum qualifications, they were not competent enough to deliver the practical components in the subject under study. The fact that they highlighted having difficulties in delivering practical components in the learning area such as, failing to use modern day equipment or apparatus bear testimony to how grave the situation is in schools. Teachers and administrators attributed this underperformance to the training they received in Teachers' Training Colleges which is no longer viable and or at par with the technological advancement and innovations that have taken place in the area of Science and technology. What it means is that, the academic knowledge that teachers have when they finished training is sometimes no longer viable with the way Combined Science is being delivered in the new curriculum.

One of the schools studied was understaffed due to the economic meltdown that dented the Zimbabwean economy in the past years. As a result, the education system was left with a deficit in human resources. This move implied jeopardizing the delivery of the science and technology curriculum as some new recruits lacked the fundamental pedagogy as well as methodologies for the delivery of quality in science and technology. Findings of the study unearthed that teachers' perceptions affected the way they delivered Combined Science. Instead, they concentrated on those topics they had knowledge and interest in most. The study also found out that morale is an important teacher attribute which affects the way they perceived teaching both positively or negatively. Findings also revealed that teachers 'morale had been dampened. This was attributed to the death in equipment, tools and infrastructure in schools. This called for in-service of teachers through workshops, capacity building and training to be well equipped to impart the required skills and techniques to the learners for self-reliance. As a result, teachers should have enough knowledge to impart the right skills to the learners.

Furthermore, findings of the study revealed that the learners felt that the time for practical components on the time table was too short for it would not give them ample time to acquire the

required skills for self-reliance or prepare them for examinations and future employment. It emerged from the study that teachers experienced various challenges in teaching Combined Science practical lessons due to lack of resources, lack of proper facilities, inadequate time slot, inexperienced staff and large classes, lack of top management support and inertia. The current study further established that lack of knowledge on how to teach Combined Science practical lessons was the biggest challenge in selected secondary schools. It was found that some Combined Science teachers held diplomas while others had degrees but did not possess the teaching qualifications.

5.2.3 Sub-Research Question 3

How can the practical components be taught at 'O' level for improved performance and self-reliance?

The study analysed actions for effective learning and teaching of Combined Science practical components at secondary school for sustainable performance. The results showed that, continuous training, strategic partnerships, effective infrastructure development, elimination of negative attitude, effective communication, adequate allocation of learning time for practicals, engage experts, take learners on field trips or natural trips, provision of refresher workshops, teacher capacity building, project based learning and utilization of social technologies were some of the important actions for effective learning and teaching of Combined Science at secondary school level. It also emerged in the study that relevant materials and equipment should be made available at the beginning of every academic year. Furthermore, it was indicated that capacity building workshops on improving and conducting practical works in Combined Science should be organised regularly for the teachers. Thus, meaningful efforts should be directed towards addressing the identified challenges in order to motivate the teachers to include practical works in their teaching of Combined Science.

5.3 Conclusions

The study attempted to answer the main research question which examines how Combined Science curriculum is delivered in Zimbabwean secondary schools. It was established that the delivery of Combined Science in secondary schools had been marred by an array of problems.

Teachers were finding difficulties in teaching the practical components in the subject area due to incompetency. This had been aggravated by the fact that the training the teachers received in Teacher Training institutions no longer match with the pedagogy they have to deliver to Combined Science learners in this decade. This acted in detriment to the learners who are at the receiving end for they are not equipped with the necessary hands-on skills when they leave secondary education. Findings affirm that the use of obsolete and defective equipment, tools and materials, dampened morale and negative perceptions further intensified this challenge. However, this study conceded that although teachers had the suitable minimum requirements to teach at secondary schools, it is the professional aspect on the delivery of Combined Science practicals which is a source of the concern. From the findings, it can be concluded that there were inadequate instructional materials used in the teaching and learning of Combined Science in the rural areas of Zimbabwe. It was also revealed that poor or no network connectivity was also a hindrance to both teachers and pupils in the teaching and learning of Combine Science.

The delivery of Combined Science was further strained by the lack of cooperation between schools, the Ministry of Primary and Secondary Education and industries. Most of the challenges teachers and learners encountered stem from the fact that the government do not consult industries and other stakeholders when they designed the Combined Science curriculum. This study had put more value and emphasis to those key issues that could pose serious challenges to the delivery of Combined Science curriculum within the institutional context which need to be borne in mind and be addressed consistently. To this end, the research study suggested a number of solutions to these challenges such as leveraging new technology and innovations, in-service training for teachers, workshops and developed modern infrastructure, use of resource persons, highlighting the benefits of learning science and technology, engaging learners in field trips and elimination of negative attitude in both the teachers and learners.

5.4 Recommendations

Based on the findings of this study, the researcher advanced the following recommendations to Combined Science curriculum designers, policy-makers as well as stakeholders in primary and secondary education;

5.4.1. The quality of the existing teaching force must be improved mainly through extensive staff development training programmes, including those teachers who trained long back to equip them with technical skills that are in line with the new technologies, innovations and global trends. Teachers should upgrade their knowledge and skills so as to keep abreast with the new technology in the turbulent environment. This would enable them to produce learners with the required competence for the future;

5.4.2. Teacher training should include the use of modern tools and equipment so as to equip teachers with the relevant skills needed in the delivery of Combined Science practical;

5.4.3. There should be collaboration among government, schools, parents, and the industry during curriculum design and monitoring to improve the learning and teaching of the subject, as well as ownership of programmes. Thus, there is need for schools and industries to work together in coming up with a curriculum which is in line with what is on the ground in the world of work. This would enable learners to have a swift transition from secondary schools to industries;

5.4.4. Time for practical components should be lengthened so that learners leave the school well equipped with relevant skills and knowledge for use in the world of work;

5.4.5. There was need for government, to see to it that, equipment, chemicals, materials, workshops and laboratories in schools matched the standard in industries. It should come up with mechanisms as a way of assisting schools purchase the required apparatus, chemicals and equipment which is in line with the changing technologies in industries so that learners do not lag behind in terms of skills development;

5.4.6. Teachers needed to switch from the old traditional teaching methods which were teacher centered to more modern learning methods which allow for active learning and increased learner participation, such as field trips, natural trips, project based learning and online learning as well as research;

5.4.7. The Government of Zimbabwe should look to it that the remuneration package given to teachers should be favorable so as to retain them and be motivated for better performance to the learners;

5.4.8. All relevant stakeholders should accept change through a behavior change process and not resist it for the success of technology adoption for improved performance in learners as change is inevitable and usually a necessity;

5.4.9. Primary and secondary schools should be provided with well-equipped laboratories and the necessary materials specified in the subject syllabus should be provided for use at the beginning of each academic year;

5.4.10. The people responsible for drawing the schools' academic calendar and scheme of works should ensure that topics with practical works that might be affected by bad weather conditions are allocated within the right time of the year.

5.5. Recommendations for Further Research

The findings of this study established that there were some areas which required further research. Therefore, this study had proposed the following as areas for future study:

5.5.1 This was a case study of the learning and teaching of Combined Science practical components in Goromonzi district, Mashonaland East province in Zimbabwe only, there may be need to carry out similar studies at a wider scale. Alternatively, a quantitative research methodology and design is also recommended. This will help to generalize the countrywide findings and to take the desired measures.

5.5.2 Further research is also proposed on government policy implications on technology and innovation in education with special reference to secondary school learners in science and technology .

REFERENCE

Abu-Raheem, B.O (2016). Effects of Instructional Materials on Secondary Schools Students' academic Achievement in Social studies in Ekiti State, Journal *of Education,* 6 (1):1-7.

Abdu-Raheem, B.O., and Oluwagbohunmi, M.F. (2015). Pre-service teachers‟ problems of improvisation of instructional materials in social studies in Ekiti State University. *Journal of Education and Practice,* 6(3), 160-163.

Aelfil M and Negida, A (2017). *Sampling methods in clinical research: An educational review Department of medical sciences*, Logos: University of Medical Sciences.

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):1-14.

Akuma, F.V and Callaghan. (2016). Framework for Reducing Teaching challenges relating to improvisation of science education equipment and materials in schools. Eurasia. *Journal of Mathematics, science & technology education, (*1), 2:197-217

Ali, M. (2015). Using technology in the classroom: A study with Turkish pre-service EFL teachers. *The Turkish Online Journal of Educational Technology*, 14(2), 229–240.

Alvarado, J.L (2017). Educational Research: Educational purposes, The Nature of knowledge and Ethical issues, Research education stirring FK8IPT UK. *International Journal of Research Education, 2(2):1-12*

Anamuah-Mensah, J., Ananga, E.D., Wesbrook, J., and Kankam, G. (2017). *National Teachers' Standards for Ghana-Guidelines*. Logos: Ministry of Education.

Ashley, C. (2019). *Overview of Qualitative Research Methods*, https://wwwthought co./qualitative-research methods. Accessed 12 May 2022.

Azure, J.A. (2015). Senior High School Students' views on the teaching and learning of integrated science in Ghana. *Journal of Science Education and Research*, 1(2), 49-61.

Bans-Akutey, A.; Tiimub, B.M (2021) *Identifying Research Gaps in Scholarly work- A Review. Academia letter*. Article 3232 https://do.org/10.20935/AL3237. Accessed 23rd August 2021.

Bans-Akutey, A.; Tiimub, B.M (2021). *Triangulation in Research. Academia letter*. Article 3392 https://do.org/10.20935/AL3392. Accessed 23rd August 2021.

Bansilal, S. (2015). Exploring student teachers' perceptions of the influence of technology in learning and teaching mathematics. *South African Journal of Education*, 35(4), 1–8.

Barrett, P. S., F. Davies, Y. Zhang, and L. Barrett. (2015). "The Impact of Classroom Design on Pupils' Learning: Final Results of a Holistic, Multi-Level Analysis*." Building and Environment* 8(9): 118–33

Barrett, P. Treves, A. Shmis, T. Ambasz, D.and Ustinova, M. (2019) *Impact of School Infrastructure on Learning. Synthesis of the Evidence. International Development in Form/World Bank Group. International Bank for Reconstruction and Development 1818 first street*, Washington.

Bello, S. (2015). Effect of some teacher factors on the conduct of effective biology practical lesson. *Global Advanced Research Journal of Educational Research and Review*, 4(3), 048-054.

Bialik M, Fadel C (2017) *Overcoming System Inertia in Education Reform*. Logos: Centre for Strategic education.

Blackstone, A.(2018) *Principles of sociological inquiry*: *Qualitative and Quantitative methods,* https://open library repo=ecamusonntano.ca. Accessed 2nd April 2022

Botes, W. (2021). *The development and use of improvised science teaching models: A case of Natural science pre-Service teachers,* International Journal of Learning, Teaching and Educational Research, 20 (5):18-37.

Bryman A. & Bell, E. (2015). "*Business Research Methods" 4th edition*, Oxford University Press.

Bruns, H. (2017). *supporting technical and vocational education and training (TVET) Reform in Pakistan.* Giz.de.https;//www.giz.de/en/worldwide 26/783 html. Accessed 30 October 2022.

Chief Examiners' Report. (2019). *General Resume of the Chief Examiners' Reports on the Basic Education Certificate Examination for School Candidates, 2017*. https://www.thesisexamples.

blogspot.com/2018/08/chief-examiners-report-on-bece-2017.html. Accessed on November 20 22.

Combined Science Teachers Guide. (2015). 2015-2022, Ministry of Primary and Secondary Education. Harare: Zimbabwe.

Chimhenga, D. (2015) *Student-Teachers perspectives of monitoring Practices during their teaching practicum in Zimbabwean Schools*. *Global Journal of Advanced Research,* 3 (5):405-410.

CRQ. (2015). *Overview of quantitative research methods [video file]*. *Centre for Research Quality*. https://www.youtube.com/watch?v=cwU8as9ZNlA . Accessed 16th August 2022.

Creswell, J. W., & Creswell, J. D. (2017). *Research design: Qualitative, quantitative, and mixed methods approaches*. London: Sage publications.

Creswell, J. W., & Creswell, J. D. (2015). *Educational Research: Planning and Evaluating qualitative approaches to research 5th ed. Upper Saddle River,* NJ Merrill/Pearson Education ltd.

Darko, R.O, Offei-Ansah, C.; Shougi, Y and Jun-ping, L (2015), Challenges in the teaching and learning of agricultural science in selected public senior High schools in the Cape Coast Metropolis. *Agricultural Science, (3)1:3-20,*

Davies, H.A (2015). Conceptualizing the role of student teacher relationships on children's social and cognitive development educational psychologist. *Educational Journal,* 3(8): 207-234

Deshmane, S.B. (2016*).* Impact of Science and Technology on Indian Rural Society: A Sociological Study. *Imperial Journal of Interdisciplinary Research, 2(13*), *39-42*.

Dewey, J. (2016). Democracy and Education an ERA of Globalization. *Educational Studies,* 5(2), 33-39

Donkoh, S. (2016). Teaching Science in Rural Communities*; International journal of Innovative Research and Advanced Studies,* 3 (7):-12.

Eze, P. I. (2018). Effectiveness of improvisation of instructional materials on students' academic achievement and retention in Christian religious studies. *Educational Studies, 5(2), 33-39.*

Fink, K. (2020) Amazing educational virtual field trips—Spring. *Educational Studies, 5(2), 33-39.*

Fleischmann, E. M. L. & Van der Westhuizen, C. P. (2017). The Interactive-GIS-Tutor (IGIST): An option for GIS teaching in resource-poor South African schools. *South African Geographical Journal*, 99(1), 68-85..

Forster, P. Quarcoo, R. Ashong, E L and Ghanney. V (2017). Views of teacher trainees on Clothing Textiles education in two teacher universities in Ghana world. *Journal of education*, 7 (1): 1-3

Gbadamosi, T.V. (2018*). Effects of Service learning and Education Trips; Instructional Strategies on Primary School Pupils' Environmental literacy in Social Studies In Oyo State*, Nigeria. *Interantional Journal of Social Sciences*, 2(3):1-16

Gorghiu, G., Draghicescu, L. M., Cristea, S., Petrescu, A. M. & Gorghiu, L. M. (2015). Problem-Based Learning - An Efficient Learning Strategy in the Science Lessons Context. *Procedia Social and Behavioral Sciences, 19(1): 1865 – 1870.*

Gosky, A. (2016). Organizational Change Management Strategies in Modern Business. IGI Global. *Educational Studies, 5(2), 33-39*

Gosky, A. Vayvay, O.and Yilmaz. (2017). Electronic Collaboration in Strategic decision making process. An application in a global leading company. In Remote work and collaboration: Breakthrough in research and strategies. *Educational Studies, 5(2), 33-39*

Gudyanga, A, (2014) Vocationalisation of education. In R.J Zvobgo (ED) *contemporary issues in education (pp.101-114).* Gweru: Mambo printers.

Grover, V.K (2015). Organizational Change Management Strategies in Modern Business. *International Multidisciplinary Research Journal, Golden Research Thoughts., 6(2):1-12*

Grix, J. (2018). *The foundations of Research 3rd Ed*, Bloomsbury Publishing

Heale, R and Twycross, A (2015). *Validity and Reliability in Quantitative Studies*, Evidence based research.

Holloway, I & Galvin, K. (2017), *Qualitative Research in nursing and healthcare*. (4th ed). Oxford: Wiley Blackwell.

Ingwenagu, C (2016) *Fundamentals of research methodology and data collection*. Nigeria LAP Lambert Academic Publishing

Jackson, R. Camara, S.and Drummond, D.K (2016). *What is Quantitative Research?* Routledge Taylor and Francis Group.

Joana, A, selase, G.R selorm and Emefa A, F (2015). Improving the skill component of clothing and textiles among students in social cycle institution in Ghana and its effect on the polytechnic

fashion student. A case study of OLA girls, Mawuko girls and Mawuli senior high schools in HO, Ghana, *Journal of education and practice* 6 (27): 20-27.

Julian Tours (2018). *The hardest problems for field trip organizers – and how to solve them. International Multidisciplinary Research Journal, Golden Research Thoughts. 6(2):1-12*

Kadziya, L and Ndebele. C. (2020). *An Analysis of the challenges faced by teachers in the delivery of science technology and mathematics education in rural day secondary schools in Zimbabwe*.

Kahu, E. R., Nelson, K., and Picton, C. (2016). "*I'm excited!" Student expectations prior to starting their first year at university. Students Transitions Achievement Retention and Success Conference*. Perth. Proceedings of STARS.

Kahu, E. R., and Nelson, K. J. (2017). *Student engagement in the educational interface: Understanding the mechanisms of student success*. Manuscript in preparation. *International Multidisciplinary Research Journal, Golden Research Thoughts., 6(2):1-12*

Kasiyo, C., Denuga, D., and Mukwambo, M. (2017). An investigation and I intervention on Challenges faced by Natural Sciences Teachers when conducting practical work in three selected schools of Zambezi Region of Namibia. *Journal, Golden Research Thoughts, 34(1), 23-33*.

King, N:and Brooks. (2017). *Template Analysis for Business Management Students,* SAGE Publishing.

King, N; Horrocks, C; and Brooks (2018). *Interviews in Qualitative Research 2nd Ed*. SAGE Publishing.

As hley, C. (2019). *A n Over view of Qualitative Research Methods*. Retrieved from https://ww w. though t co.com/q ualitative-rese arch-meth ods-302 655. Accessed on 15 September 2022

As hley, C. (2019). *An Overview of Qualitative Research Methods*. Retrieved from https://ww w. though t co.com/qualitative i ve-rese arch-meth ods-302. Accessed on 15 September 2022

Knight, G (2018) *Data management for interview and focus group resources in health. London school of hygiene and Tropical Medicine Unpublished*. http, // research online. Istitm acc uk 64 464663.Accessed on 15 September 2022.

Kola, A. J and Langenhoven, K. (2015). The teaching Methods in science Education: The need for a Paradim Shift to peer Instruction (PI) in Nigerian Schools. *An international Journal of Academic Research and Reflection*, 1(3): 1-15

Komolafe.F. (2016) Reinforcing psychomotor skill of clothing and textile teachers in Nigerian secondary schools. *Journal of education and practice* 6 (27): 20-27

Kostjens, I, and Moser A series (2017): *Practical guidance to qualitative research. Part 1 introduction*. EUR j gen pract 2017 23: 271-273

Kothari, C.R (2021). *Research Methodology: Methods and Techniques 2nd ed.* New Publishers Age.

Kowalczyk, D. (2016). *Research methodologies: Quantitative, qualitative, and mixed methods [video file]*. http://study.com/academy/lesson/research-methodologies-quantitative-qualitative-mixed-method.html. Accessed 21st Septemnber 2022.

Kubai, E. (2019). *Reliability and Validity of Research instruments*, Lusaka, UNICAF

Liu, M-H., and Kleinsasser, R. (2015). Exploring EFL teachers' knowledge and competencies: In-service program perspectives. *Language Learning & Technology*, 19(1), 119–138.

Mabasa, T., & Singh, S. (2020). *Decolonizing continuing teacher professional development in the teaching of physical science through improvisation in rural areas.* South African Journal of Higher Education, 34(3), 146-163. https://doi.org/10.20853/34-3- 3455. Accessed 10th August 2022.

Macmillan, J.H (2015). *Fundamentals of Educational Research*. London: Pearson Education.

Miles, R. (2015). Tutorial instruction in science education. *Cypriot Journal of Educational Science, 10(2), 168-17*

Mishra, S.B and Alok, S. (2017). *Handbook of Research Methodology*. *A compendium for scholars and Researchers*, Edu cream Publishing, India.

Morris, T. and Wood, S. (2015). *Testing the Survey Method: Continuity and Change in British Industrial Relations' Work Employment and Society*, Oxford Blackwell

Moser, A and KorstJens, I (2018): Series practical guidance to qualitative research. Part3 sampling data collection analysis. *European journal of general practice* 24(1): 9-18

Mtsi, N., & Maphosa, C. (2016). *Challenges encountered in the teaching and learning of the natural sciences in rural schools in South Africa.* Journal of Social Sciences, 47(1), 58-67.

Umugiraneza, O., Bansilal, S., and North, D. (2017). *Exploring teachers' practices in teaching mathematics and statistics in KwaZulu-Natal schools. South African Journal of Education,* 37(2):1-13

Umugiraneza, O., Bansilal, S. and North, D. (2018b). Exploring teachers' descriptions of 'ways of working with the curriculum' in teaching mathematics and statistics. *African Journal of Research in Mathematics, Science and Technology Education,* 22(1), 70–80.

.

Wrigley, C., & Straker, K. (2017). *Design thinking pedagogy: The educational design ladder. Innovations in Education and Teaching Internationa*l, 54(4), 374-385.

Yakubu, A.S. (2018). *Questionnaire Research Methodology*, Cyprus : International University.

Yeboah, R., Abonyi, U. K. & Luguterah, A. W. (2019). Making primary school science education more practical through appropriate interactive instructional resources*:* A case study of Ghana. *Cogent Education*, 6(1), 1-14.

ZIMSEC (2018). *Biology examination report*. Harare: Government Printers.

ZIMSEC (2015). *Biology examination report*. Harare: Government Printers.

APPENDIX 1: INTERVIEW GUIDE

INTERVIEW GUIDE WITH ADMINISTRATORS IN EDUCATION [TEACHERS AND HEADS OF SCHOOLS]

A. PERSONAL INTRODUCTION

My name is Thula Kaunye, a student with the Bindura University of Science Education. In partial fulfilment of the Bachelor of Science Education Honours Degree in Chemistry**,** students are expected to engage in a field research and produce a research project covering their areas of interest.

The research area is 'Exploring the Teaching and learning of 'O' level Combined Science Practical Component at rural schools in Zimbabwe: A case study of two secondary schools in Mashonaland East province'. Of interest is the outcomes of the change in the teaching and learning of Combined Science practical's after administering new methodologies. Your views pertaining to the area under study will be most welcome. I can assure you that the information you are going to provide will be kept private and confidential. I will, with your consent, would like to record the interview for quality and training purposes and would like to assure you that the contents of the interview are to be used purely for academic purposes. The data would be coded and destroyed as soon as I finish transcription. However, you retain the right to withdraw from the research at any time should you wish to do so. With this and your consent I wish to start the interview.

B. BACKGROUND INFORMATION

1. Position Held or Title.
2. Experience in the education sector.
3. Which level of professional qualifications and skills did you attain in teaching Combined Science?

C. INTERVIEW QUESTIONS

4. What are the challenges being faced in the teaching of Combined Science practical at your school?

5. Which instructional materials do you use in teaching Combined Science practical to the learners at 'O' level?

6. (a). What is the teacher/pupils ratio in teaching Combined Science practicals at the school?

   (b). Is this ratio viable?

7. Do you attend subject related workshops and what are their benefit to the teaching and learning of Combined Science practical?

8. What tools are required for effective teaching of the subject component under study?

Thank you for taking time to respond to my questions

APPENDIX 2: QUESTIONNAIRE

QUESTIONNAIRE FOR THE LEARNERS

BRIEF

My name is Thula Kaunye, a student with the Bindura University of Science Education. In partial fulfilment of the Bachelor of Science Education Honours Degree in Chemistry**,** students are expected to engage in a field research and produce a research project covering their areas of interest.

The research area is 'Exploring the Teaching and learning of 'O' level Combined Science Practical Component at rural schools in Zimbabwe: A case study of two secondary schools in Mashonaland East province'. Of interest is the outcomes of the change in the teaching and learning of Combined Science practical's after administering new methodologies. Your views pertaining to the area under study will be most welcome. I can assure you that the information you are going to provide will be kept private and confidential. However, you retain the right to withdraw from the research at any time should you wish to do so.

INSTRUCTIONS

1. Do not write your name on the copy.
2. Please respond to the following questions in the spaces provided.

SECTION A: DEMOGRAPHIC INFORMATION

1. Please indicate your gender

Female ☐	Male ☐

SECTION B:

2. What are the challenges being faced in the teaching of Combined Science practical at your school?

Response	**Tick**
Obsolete training equipment	
Lack of textbooks	
Lack of training material	
Large classes	
Lack of well-equipped science laboratories	
Too much sharing of equipment and tools	
Insufficient time for the practical work	
Poorly equipped school for the practical component of the subject.	
No field trips or nature trips	
Learning without protective clothing eg dustcoat,worksuit,safety goggles and gloves	
Use of non-interactive teaching methods such as lecture method	
All of the above	

Any other, specify

_____

_____

_____

_____

_____

3. Are learners given enough time to do their practical work?

_____

_____

_____

_____

_____

_____

4. (a) How often do learners meet for practical work in Combined Science at your school?

_____

_____

_____

(b). How long is the practical period/session?

_____

_____

_____

_____

5. What do you think can be done to improve the teaching and learning of Combined Science practical at "O" level?

Response	**Tick**
Learner to choose the subject	
Schools to priorities Combined Science needs first	
Government to provide refresher workshops for Combined Science teachers	
Workshops; modern laboratories ; tools; equipment and other instructional materials to be adequately availed at the school	
Trained assessors required to assess student's competences	
More time for practical work must be provided	
Competent, skilled and proficient teachers are required	
Field Trips or natural trips to encouraged	
Well trained and equipped resource persons	

Use of interactive teaching methods such as demonstration method and project –based method	
All of the above	

Any other, specify:

_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

THANK YOU…

APPENDIX 3. LETTERS OF PERMISSION TO CARRY OUT RESEARCH

DEPARTMENT OF EDUCATION

P Bag 1020
BINDURA
ZIMBABWE

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

BINDURA UNIVERSITY OF SCIENCE EDUCATION

TO WHOM IT MAY CONCERN

NAME: KALINDE TIKULA REG NUMBER: B2115238

PROGRAMME: *HBScEd Physics/Maths/Chemistry/Biology* PART: 2.1

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

The student has to undertake research and thereafter present a Research Thesis in partial fulfillment of the Bachelor of Science Education Honours Degree programme. The research topic is:

Exploring the teaching and learning of ordinary level combined science practical competencies in rural areas.

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

Your co-operation and assistance is greatly appreciated.

Thank you

N Zezekwa (Dr.)
CHAIRPERSON - DEPARTMENT OF SCIENCE AND MATHEMATICS EDUCATION

APR 2022

P. BAG 1020
BINDURA

All communications should be addressed to
"The Secretary for Primary & Secondary Education
Telephone: 794895
Telegraphic address : "EDUCATION"

ZIMBABWE

Reference: C/426/3
Ministry of Primary and Secondary Education
P.O Box CY 121
Causeway
HARARE

20 July2022

Tula Kaunye
Chinyika High School
P Bag 18
Goromonzi

RE: PERMISSION TO CARRY OUT A RESEARCH IN MASH EAST PROVINCE: GOROMONZI DISTRICT: TAKURA AND CHINYIKA SECONDARY SCHOOLS.

Reference is made to your application to carry out research at the district mentioned above in schools on the research title:

"EPLORING THE TEACHING AND LEARNING OF ORDINARY LEVEL COMBINED SCIENCE PRACTICALCOMPONENTS IN RURAL AREAS"

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

You must provide a copy of your final report to the Secretary for Primary and Secondary Education.

MIN. OF PRIMARY AND SECONDARY EDUCATION POLICY PLANNING RESEARCH AND DEVELOPMENT 28 JUL 2022 P.O. BOX CY 121, CAUSEWAY ZIMBABWE

Muingarimi Hebert
RESEARCH OFFICER

For: **SECRETARY FOR PRIMARY AND SECONDARY EDUCATION**