BINDURA UNIVERSITY OF SCIENCE EDUCATION

INVESTIGATING PRIMARY TEACHERS' PREPAREDNESS TO TEACH CHEMISTRY AT RUNENE PRIMARY SCHOOL.

BY

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B225775B

A DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS OF BACHELOR OF SCIENCE EDUCATION HONOURS DEGREE IN MATHEMATICS

FACULTY OF SCIENCE AND MATHEMATICS EDUCATION DEPARTMENT

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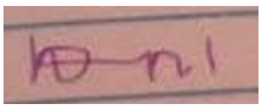
Submitted ………………………………in partial fulfillment of the requirement of the Bachelor of Science Education Honours Degree in Mathematics.



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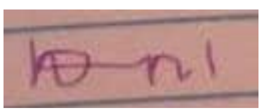

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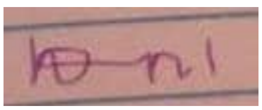
DECLARATION

I, Mariseni Aannah declare that this research project for a Bachelor of Science Education Honours Degree in Mathematics at Bindura University of Science Education is my own design and execution. I further certify that the document has not previously been submitted to this or any other University in support of an application for a post, degree or any other qualification.



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DEDICATION

I want to take a moment to express my heartfelt gratitude to the Almighty for His unwavering support and guidance throughout the journey of this project. Truly, God is great, and I am endlessly thankful for the blessings and inspiration that have been bestowed upon me. I would also like to dedicate this project to my beloved husband and our amazing children: Caleb, Angel, Kudzaishe, Asah, and Tanatswa Mariseni. Each of you has played a vital role in my life, providing love, encouragement, and motivation, which have been invaluable in bringing this project to fruition. Your support has been a constant source of strength for me, and I hope this work reflects the love and dedication I have for our family.

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I would like to take this opportunity to express my heartfelt gratitude to my supervisor, Dr. G. Sunzuma, for her unwavering support, guidance, and immense patience throughout the entire process of writing this dissertation. Her insightful feedback and encouragement have been invaluable in shaping my research and enriching my academic experience. Additionally, I would like to extend my sincere thanks to my friends and fellow classmates, whose inspiration, camaraderie, and constructive discussions have played a significant role in motivating me and fostering a collaborative environment. Their unwavering belief in my abilities and the countless moments we shared during this journey have made this experience not only enriching but also truly enjoyable.

ABSTRACT

The main objective of this qualitative research study was to investigate the challenges faced by primary school teachers in teaching chemistry concepts under STEM education within the Heritage-Based Curriculum. A qualitative research approach using an interpretative research paradigm was employed to collect data through in-depth interviews with 5 primary school teachers and observations of their teaching practices. Additionally, interviews were conducted with 10 students to gather their perspectives on the challenges they face in learning chemistry concepts. The major findings of the study revealed that primary school teachers face numerous challenges in teaching chemistry concepts under STEM education, including lack of resources, inadequate teacher training, and insufficient curriculum support. The study also found that students struggle to understand complex chemistry concepts due to inadequate teaching methods and resources. Furthermore, the study revealed that the Heritage-Based Curriculum presents additional challenges for teachers, as it requires them to integrate cultural heritage into their teaching practices. Based on the findings, the study recommends that the government and educational authorities provide primary school teachers with adequate resources, training, and curriculum support to teach chemistry concepts effectively. Additionally, the study recommends that teachers be encouraged to use innovative and interactive teaching methods to engage students and promote deeper understanding of chemistry concepts. Finally, the study recommends that the Heritage-Based Curriculum be reviewed and revised to ensure that it is aligned with the needs of primary school teachers and students.

ABBREVIATIONS

AST - Agriculture, Science, and Technology

CAS - Curriculum and Assessment System

CPD - Continuous Professional Development

CPR - Collaborative Professional Relationships

CQI - Continuous Quality Improvement

CSES - Community Science Education Support

ECD - Early Childhood Development

HBC - Heritage-Based Curriculum

ICT - Information and Communication Technology

KPI - Key Performance Indicator

LTSM - Learning and Teaching Support Materials

NC - National Curriculum

NSC - National Science Curriculum

PBL - Project-Based Learning

PISA - Program for International Student Assessment

PPP - Public-Private Partnership

R&D - Research and Development

SAA - Science Achievement Assessment

STEM- Science, Technology, Engineering, and Mathematics

ZIMSEC - Zimbabwe School Examinations Council

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

The Zimbabwean government introduced the heritage-based curriculum in 2016 to promote cultural relevance and contextual learning.Under the heritage-based curriculum, Chemistry concepts are integrated into the Agriculture Science and Technology subject, aiming to develop scientifically literate citizens. However, primary school teachers often lack specialized training in chemistry, hindering effective teaching practices.

Runene Primary School, located in a rural area, faces resource constraints and limited access to chemistry equipment and materials. This study seeks to understand the challenges and opportunities for teaching chemistry concepts in this context.

How Chemistry Concepts were Taught in the Old Curriculum

According to Mavhunga, E. (2014) before STEM education was introduced under the new curriculum, chemistry related concepts were taught under Content subject under the old curriculum (pre-2016), in Zimbabwe primary education. The content was integrated into various topics, focusing on basic chemical concepts and processes. Chemistry concepts were taught using a content-based approach, focusing on transmitting knowledge and facts. According to Zimbabwe Ministry of Education, Sport, Arts and Culture (2010) the teaching methods included lectures, demonstrations, experiments (simple), textbook-based learning. The assessment focused on recalling facts and concepts, with an emphasis on written tests and exams. Mavhunga (2014) asserted that the old curriculum had a more fragmented approach to science teaching, with less emphasis on practical applications and critical thinking. This led to the introduction of the new curriculum in the year of 2016, as part of the new curriculum framework, which aimed to address these limitations by adopting a more integrated and inquiry-based approach.

According to Chitamba et al., (2020) prior to 2016, chemistry education in Zimbabwe primary schools focused on theoretical knowledge, with limited practical applications. For example, the old curriculum emphasized memorization of chemical formulas and reactions limited resources and infrastructure hindered practical learning. In contrast, STEM education under the heritage-based curriculum emphasizes contextual learning, relating chemistry concepts to everyday life, practical applications, using local resources and materials and integration with other subjects, such as agriculture and technology.

Why STEM Education was Introduced in Zimbabwe Primary Education

Stem was introduced for economic development and workforce needs. Zimbabwe recognized the importance of STEM education in developing a skilled workforce to drive economic growth and technological progress. Machingambi (2018) asserts that Zimbabwe has placed a strong emphasis on STEM education to develop the necessary skills and knowledge for the country's economic development and competitiveness.

Chitamba et al. (2020) underscored that the improvement of educational outcomes was another reason why STEM was introduced. STEM education was seen as a way to enhance the overall quality of education and student learning outcomes in Zimbabwe. A study published in the International Journal of STEM Education states that the introduction of STEM education in Zimbabwean primary schools aimed to improve the teaching and learning of STEM subjects and enhance students' performance in these subjects. Mudyahoto (2020) alludes that STEM was introduced in order to address gender disparities. Zimbabwe recognized the need to encourage the participation of girls and underrepresented groups in STEM subjects. The UNESCO IIEP report mentions that the Science, Technology and Mathematics (STM) Education Programme aimed to promote the participation of girls and other under-represented groups in STEM-related subjects and activities.

STEM in Zimbabwean Primary Education Include:

In STEM education there is curriculum integration. According to News Day (2017) the primary school curriculum in Zimbabwe integrates STEM subjects across various grade levels. The integration may be seen when teaching about fertilizers or even water pollution in Agriculture and teaching hygiene in Physical education. According to a report by UNESCO, the Zimbabwean primary school curriculum places significant emphasis on science, technology, engineering and mathematics (STEM) subjects, with these subjects being taught from an early stage.

There is also practical and hands-on approach. The teaching of STEM subjects in Zimbabwean primary schools often involves practical and hands-on activities. This is seen when simulating chemical processes such as separating mixtures or using baking soda and vinegar to demonstrate chemical reactions. A study published by Cooper (2020) STEM Education states that the teaching of STEM subjects in Zimbabwean primary schools incorporates practical and hands-on activities, such as experiments, project-based learning, and the use of educational technology.

Four Components of STEM include:

S- Science: learning about plants, animals, and the environment

T- Technology: basic computer skills, coding, and robotics

E-Engineering: designing and building simple structures

M- Mathematics: problem-solving, geometry, and measurement

Aspects of Chemistry in the Agriculture, Science and Technology subject

Agriculture: Soil science, fertilizers and pesticides, crop nutrition, animal nutrition.

Science: Properties of materials, chemical changes, acids and bases, elements and compounds.

Technology: water treatment, energy sources, material technology

At primary level, chemistry concepts are introduced through: Basic chemistry concepts (Grade 4-5): Introduction to matter, elements, and compounds, Chemical reactions (Grade 6-7): Introduction to chemical changes and reactions.

Problems with the components of chemistry in the Agriculture, Science and Technology

In Agriculture, Mavhunga (2017) underlines that limited practical experience and outdated curriculum hinders students' understanding of chemical applications in farming. According to Mudzingwa (2019) lack of resources and poor teacher training exacerbate the situation. Disconnection from local context further limits the relevance of chemistry in agriculture. (Zimbabwe Ministry of Primary and Secondary Education, 2019). In Science, Mapolisa (2017) articulates that the emphasis on theoretical knowledge overshadows practical applications, while limited laboratory facilities and outdated textbooks hinder experimentation and learning. Teacher shortages and language barriers further compromise science education.

In Technology Makoni (2019) asserts that limited access to technology and an outdated curriculum hinder students' acquisition of technical skills. Disconnection from industry and inadequate assessment methods further limit the effectiveness of technology education. According to Zimbabwe Ministry of Primary and Secondary Education (2020) the heritage-based curriculum's emphasis on STEM education has highlighted the need for urgent attention to this issue. The heritage-based curriculum in Zimbabwe primary schools aims to contextualize chemistry education by incorporating cultural relevance and local resources. At Runene Primary School, teachers without formal chemistry training are required to teach chemistry related concepts under Agriculture, Science and Technology in STEM subjects from ECD to Grade 7. To address this challenge, the heritage-based curriculum was employed to make chemistry more accessible and engaging.

The heritage-based curriculum focuses on:

According to Moyo et al. (2019) the heritage-based curriculum focuses on such as cultural relevance which connect chemistry related concepts to students' everyday lives and cultural practices. Local resources when readily available materials are used to teach chemistry concepts under the Agriculture, Science and Technology subject. For example, exploring traditional medicines and herbal remedies such as those made from tree barks or roots. Storytelling is used to utilize oral traditions and stories to convey chemistry concepts which is under the Agriculture, Science and Technology subject. Practical activities which encourage hands-on learning and exploration. For example, when investigating soil fertility and composition. Community involvement which invites local experts and community members to share their knowledge.

The Choice of this Topic was Motivated by the Following Factors:

Personal experience, where as a teacher at Runene primary school, I have witnessed firsthand the challenges faced by some of the teachers in teaching chemistry related concepts under the Agriculture, Science and Technology subject. I have observed that Runene primary school teachers struggle to teach chemistry concepts effectively which is under the Agriculture, Science and Technology subject, for example, finding it difficult to perform practical experiments. Chemistry is a fundamental subject that underpins many areas of Agriculture, Science and Technology, and is essential for the development of scientific literacy. There is a need to improve the teaching and learning of chemistry concepts under Agriculture, Science and Technology at Runene primary school to ensure that students are well-prepared for secondary school and beyond.

However, research reveals challenges in teaching chemistry concepts under Agriculture Science and Technology: teachers lack specialized training in chemistry (Mudzingwa and Chimweta, 2018) limited resources and infrastructure hinder practical learning (Chitamba et al., 2020), cultural relevance requirements pose challenges (Moyo and Zvobgo, 2019). Studies have shown that effective teaching of chemistry concepts requires: specialized teacher training according to Mudyahoto and Machingambi (2020), Practical learning experiences cultural relevance and contextual learning (Moyo and Zvobgo, 2019).

1.2 STATEMENT OF PROBLEM

Despite the importance of chemistry education, research reveals that: primary school teachers lack specialized training in chemistry, leading to inadequate teaching practices (Mudzingwa and Chimweta, 2018). Limited resources and infrastructure hinder effective teaching and learning cultural relevance requirements pose challenges in teaching abstract chemistry concepts (Moyo and Zvobgo, 2019).

Ndlovu (2019) opined that despite the integration of chemistry into the Agriculture, Science and Technology primary school curriculum in Zimbabwe, teachers at Runene Primary School face significant challenges in effectively teaching chemistry concepts to students from ECD to grade seven. The majority of the primary teachers lack specialized training in chemistry, yet are required to teach the subject components as part of the Agriculture, Science and Technology subject under STEM program. Moyo.et al. (2019) asserts that this lack of training, combined with inadequate resources and support, hinders teachers' confidence and ability to deliver high-quality chemistry education, potentially depriving students of a solid foundation in the subject.

This study aims to investigate the specific challenges faced by teachers in teaching chemistry related concepts at Runene Primary School and explore potential solutions to support them in providing effective chemistry education to their students under Agriculture, Science and Technology subject.

1.3 RESEARCH OBJECTIVES

- To identify the specific challenges faced by primary school teachers at Runene Primary School in teaching chemistry-related concepts within the Agriculture, Science, and

Technology subject as part of the STEM-based Science curriculum, particularly in the absence of specialized training in the subject.

- To evaluate how the lack of chemistry-specific training and limited teaching resources impact the quality of chemistry instruction and students' understanding of the subject at Runene Primary School.

- To assess the extent to which teaching chemistry concepts under the Agriculture, Science, and Technology subject within the STEM education framework, incorporated into the heritage-based curriculum, enhances students' understanding at Runene Primary School.

1.4 RESEARCH QUESTIONS/SUBPROBLEMS

1.4.1 Research Questions:

- What are the specific challenges faced by primary school teachers at Runene Primary School who are required to teach chemistry related concepts as part of the Agriculture, Science and Technology subject under STEM-based Science curriculum, despite not having specialized training in the subject?

- How do the lack of chemistry-specific training and limited teaching resources impact the quality of chemistry instruction and students' understanding of the subject at Runene primary school?

- What strategies and interventions can be implemented to support primary school teachers at Runene Primary School in effectively delivering chemistry related concepts lessons under the Agriculture,Science and Technology subject and improving students' learning outcomes in this subject area?

- How do teachers' lack of training and expertise in chemistry related concepts impact students' understanding and performance in the subject?
- What are the specific chemistry concepts that teachers struggle to teach and students struggle to learn?

1.4.2 Sub-Problems:

- Investigate the impact of the teachers' challenges on students' learning outcomes, interest, and engagement in chemistry related concepts at Runene primary school.
- Analyze the level of chemistry content knowledge and pedagogical skills among the teachers at Runene Primary School and how it impacts their ability to teach the subject.
- Develop and propose specific interventions, such as teacher training programs, resource provision, or curriculum modifications, to address the identified challenges and improve the teaching and learning of chemistry concepts under the Agriculture, Science and Technology subject at Runene Primary School.
- Evaluate the availability and quality of teaching resources (e.g., textbooks, laboratory equipment, hands-on learning materials) used for delivering chemistry concepts instruction at Runene Primary School.

- Identify the specific chemistry concepts and topics that teachers at Runene Primary School struggle most to teach effectively.

1.5 ASSUMPTIONS

- The study's findings will be generalizable to other primary schools in Zimbabwe with similar characteristics.
- Teachers' attitudes and beliefs about teaching chemistry influence their teaching practices.
- Chemistry concepts are integral to the Agriculture, Science, and Technology (AST) subject.
- Teachers at Runene Primary School are willing to participate in the study and provide accurate information.
- The heritage-based curriculum is fully implemented at Runene Primary School.

1.6 SIGNIFICANCE OF THE STUDY

The significance of this study lies in its potential to address the challenges faced by teachers in teaching chemistry concepts at Runene Primary School, under the Agriculture, Science, and Technology under Heritage-Based Curriculum. This study will provide insights into the challenges faced by teachers in teaching chemistry concepts under AST, informing strategies to enhance teacher effectiveness and student engagement. The study's findings will contribute to the refinement of the heritage-based curriculum, ensuring chemistry concepts are effectively integrated into Agriculture, Science and Technology. The study will identify areas for teacher training, supporting the development of effective teaching practices in chemistry education. By exploring chemistry education under Agriculture, Science and Technology, this study will contribute to the advancement of STEM education in Zimbabwe primary schools (Ndhlovu et al., 2020). The study will provide context-specific solutions to challenges faced by teachers in teaching chemistry concepts under Agriculture, Science and Technology in rural primary schools like Runene Primary School.

1.7 LIMITATIONS OF THE STUDY

The study will focus on Runene Primary School, which may not be representative of all primary schools in Zimbabwe. The study will focus on a rural primary school, which may have unique challenges different from urban schools. The Heritage-Based Curriculum's emphasis on local contexts may require teachers to adapt chemistry concepts to their specific region, which can be challenging. Some teachers in Zimbabwean primary schools often lack access to resources, including textbooks, laboratories, and technology, which can hinder effective chemistry instruction (UNESCO, 2019).

1.8 DELIMITATIONS OF THE STUDY

Geographical location

The study focuses on Runene Primary School in Zimbabwe, which may not be representative of all primary schools in Zimbabwe.

Grade level

The study focuses on Grade 3-7 teachers and students, which may not be generalizable to other grade levels.

Subject area

The study focuses on chemistry concepts taught under Agriculture, Science, and Technology (AST), which may not be representative of other subjects.

1.9 DEFINITION OF KEY TERMS

Chemistry: Chemistry is a branch of science that deals with the study of the composition, structure, properties, and behavior of matter, as well as the changes it undergoes during chemical reactions.

STEM Subjects: STEM stands for Science, Technology, Engineering, and Mathematics. STEM subjects refer to the academic disciplines that fall under these four broad categories, which are considered crucial for innovation, technological advancement, and problem-solving in the modern world.

Primary School: Primary school, also known as elementary school, refers to the initial stage of formal education, typically spanning from Early Childhood Development (ECD) to Grade 7 in the Zimbabwean education system.

Content Knowledge: Content knowledge refers to the depth and breadth of a teacher's understanding and mastery of the subject matter they are required to teach, in this case, chemistry.

Pedagogical Knowledge: Pedagogical knowledge encompasses the strategies, techniques, and approaches that teachers employ to effectively deliver instruction and facilitate student learning in a particular subject, such as chemistry.

Challenges: Challenges refer to the difficulties, barriers, and constraints that primary school teachers encounter in teaching chemistry, including but not limited to content knowledge gaps, pedagogical limitations, resource availability, and other contextual factors.

Professional development: Opportunities and experiences designed to enhance teachers' knowledge, skills, and practices, including workshops, training programs, and mentoring.

1.10 SUMMARY

This study investigates the teaching of chemistry concepts under the Agriculture, Science, and Technology (AST) subject within the STEM education framework of Zimbabwe's heritage-based curriculum at Runene Primary School. The study aims to explore challenges faced by teachers, examine the impact of untrained teachers on student learning outcomes, and identify strategies to enhance teacher effectiveness and student engagement. The teaching of chemistry related concepts at Runene primary school in Zimbabwe is a critical component of the Agriculture, Science, and Technology subject in STEM subject's curriculum from ECD to Grade 7. This lack of training and expertise leads to a lack of confidence and competence in teaching chemistry concepts, resulting in inadequate teaching and learning. The background of the study highlighted on how chemistry concepts were taught in the old curriculum. It also highlighted on why STEM was introduced in the new curriculum under the heritage-based curriculum. In this chapter the statement of problem, significance of study, limitations and delimitations were highlighted.

CHAPTER TWO

LITERATURE REVIEW

2.0 INTRODUCTION

The integration of chemistry concepts into the Agriculture, Science, and Technology subject under STEM education in the heritage-based curriculum in Zimbabwe primary schools, particularly at Runene Primary School, necessitates an examination of existing literature. This review aims to provide a comprehensive understanding of the challenges, opportunities, and best practices in teaching chemistry concepts. Research has shown that effective teaching of chemistry concepts requires specialized teacher training practical learning experiences and cultural relevance (Patel, 2019). Zimbabwe's heritage-based curriculum, introduced in 2016, emphasizes contextual learning and cultural relevance. By synthesizing existing research, this study aims to interpret and evaluate relevant literature and citations. The literature to the problem is going to be contextualized and establish problem in knowledge and how the research will try to address the problem. The literature will also identify knowledge gaps and inform strategies for enhancing teacher effectiveness and student engagement in teaching chemistry concepts under Agriculture, Science and Technology under STEM education under the Heritage-based curriculum at Runene Primary School.

This literature review is based on the following research questions:

- What are the specific challenges faced by primary school teachers at Runene Primary School who are required to teach chemistry related concepts as part of the Agriculture, Science and Technology subject under STEM-based Science curriculum.
- What strategies and interventions can be implemented to support primary school teachers at Runene Primary School in effectively delivering chemistry related concepts lessons under the Agriculture, Science and Technology subject and improving students' learning outcomes in this subject area?
- To what extent does teaching chemistry concepts under Agriculture, Science and Technology subject in STEM education under the heritage-based curriculum enhance students' understanding at Runene Primary School.

2.1 INTERPRETATION AND EVALUATION OF RELEVANT LITERATURE AND CITATIONS

The integration of chemistry concepts into the Agriculture, Science and Technology subject under STEM education under the heritage-based curriculum in Zimbabwe primary schools is a critical area of study. This literature review examines challenges faced by teachers and students, the effectiveness of teaching chemistry concepts under STEM under the heritage-based curriculum at Runene Primary School.

2.1.1 Challenges faced by teachers in teaching of chemistry concepts

Teaching chemistry concepts under Agriculture, Science, and Technology (AST) poses challenges for primary school teachers (Carper and Edgars, 2020). Zimbabwe's heritage-based curriculum emphasizes contextual learning and cultural relevance (Zimbabwe Ministry of Primary and Secondary Education, 2015). Teachers lack specialized training in teaching chemistry concepts, leading to inadequate content knowledge and pedagogical skills (Chitamba et al., 2020). Difficulty teaching abstract concepts. Limited availability of textbooks, laboratory equipment, and technology hinders effective teaching and learning (Moyo, 2016). Primary school teachers face challenges, including limited training, resources, and support (Chitamba et al., 2020). Students exhibit misconceptions and lack understanding of chemistry concepts, affecting their performance in STEM subjects. The curriculum neglects cultural relevance and contextual learning, leading to disengagement and lack of interest among students (Moyo and Zvobgo, 2019).

2.1.2 Strategies interventions that can be implemented

Provide teachers with training on teaching chemistry concepts using local resources and contextual examples. Teacher training programs improved teacher confidence and student outcomes (McCoy, 2020). Contextual learning approaches enhanced student engagement and understanding (Raylotn, 2019). Develop and provide teachers with relevant resources, including textbooks, worksheets, and multimedia materials. Chitamba et al. (2020) reported that integrated

STEM approaches enhanced student engagement and motivation. Encouraging collaborative learning among students to promote critical thinking and problem-solving skills. Collaborative teacher professional development improved teaching practices (Chitamba et al., 2020). Incorporate cultural relevance and contextual learning into teaching practices to enhance student engagement and understanding (Robertson, 2020).

2.1.3 Teaching chemistry concepts under Agriculture, Science and Technology under the heritage-based curriculum

Limited resources and infrastructure (Mudzingwa and Chimweta, 2018). Poor student performance in science and mathematics (Ndhlovu et al., 2020) Limited resources and infrastructure. Inadequate teacher training and expertise and gender disparities in STEM fields (UNESCO, 2019). Research highlights the importance of teaching chemistry concepts in primary schools (Pestin, 2020). Effective teaching requires: Specialized teacher training (Mudyahoto and Machingambi, 2020). Practical learning experiences and cultural relevance (Moyo and Zvobgo, 2019). Kuhn (2020) found that teacher training programs improved chemistry teaching practices. Dlamini (2018) identified resource constraints as a significant challenge in teaching chemistry. Zimbabwe's heritage-based curriculum aims to promote contextual learning and cultural relevance (Zimbabwe Ministry of Primary and Secondary Education, 2015).

However, teacher preparedness is a concern. Teacher training is inadequate (Tristan, 2020). Limited resources hinder implementation, assessment and evaluation methods require improvement (Chitamba et al., 2020). Cultural relevance requires attention (Miller, 2019). However, implementation challenges persist, including limited resources and teacher training (Hauer and Baun, 2020). STEM education improves agricultural productivity and innovation

(Zimbabwe Ministry of Primary and Secondary Education, 2017). Heritage-based curriculum integrates local knowledge and cultural relevance. Enhances student engagement and learning outcomes (Chitamba et al., 2020)

The implementation of the Zimbabwe's STEM Policy (2017) emphasizes Agriculture,Science and Technology education. Heritage-based curriculum integrates local knowledge and cultural relevance. The implementation of Zimbabwe's STEM Policy (2017) promotes STEM education. Science and Mathematics Education Improvement Project (SMEIP) enhances teacher training (Odhiambo et al., 2019).

2.2 THEORETICAL FRAMEWORKS

2.2.1 Constructivist theory

Emphasizes student-centered learning and active construction of knowledge (Vygotsky, 1978). Teachers facilitate learning through scaffolding and social interaction. Relevant to chemistry education, as students construct understanding of complex concepts.

2.2.2 Contextual learning theory

Emphasizes learning in context, connecting abstract concepts to real-life situations (Herron, J. D. 1996). Enhances student engagement and motivation through relevant, meaningful learning experiences. Essential for Agriculture, Science and Technology education, integrating agricultural and scientific concepts (Smith and List, 2021). Constructivist theory informs teacher facilitation and scaffolding strategies. Contextual learning theory guides integration of chemistry concepts. Theoretical frameworks provide a lens for analyzing teacher practices and student learning outcomes. Student-centered approaches enhance learning outcomes. Contextual learning experiences increase relevance and engagement. Teachers should facilitate learning through scaffolding and social interaction.

2.3 CONTEXTUALIZATION OF THE LITERATURE TO THE PROBLEM

Effective teaching of chemistry concepts under Agriculture, Science and Technology in STEM education requires consideration of the local context. This subtopic contextualizes the literature review to the problem of teaching chemistry concepts under Agriculture, Science and Technology in Zimbabwe primary schools, specifically at Runene Primary School.

Key issues relevant and relating literature to research problem_

The review of related literature highlights the challenges and gaps in the teaching of chemistry concepts under the Agriculture, Science and Technology subject under STEM education in Zimbabwe primary schools specifically at Runene Primary School. Teaching chemistry concepts under Agriculture, Science, and Technology (AST) poses challenges for primary school teachers (Gueye, 2021). Zimbabwe's heritage-based curriculum emphasizes contextual learning and cultural relevance (Zimbabwe Ministry of Primary and Secondary Education, 2015). Primary school teachers face challenges, including limited training, resources, and support (Bayun and Adeo, 2020).

Contextual factors in teaching chemistry concepts and the heritage-based curriculum implementation

Zimbabwe's heritage-based curriculum aims to promote contextual learning and cultural relevance (Zimbabwe Ministry of Primary and Secondary Education, 2015). However: Teacher preparedness is a concern. Resource availability is limited (Beta, 2018). Assessment and evaluation methods require improvement (Cooper, 2020)

Using local plant species to teach photosynthesis and respiration (Udit,2019). Investigating soil fertility and crop rotation using inquiry-based learning (Chitamba et al., 2020). Exploring traditional agricultural practices to understand chemical reactions (Herron, 1996). Research highlights the importance of contextual factors in teaching chemistry concepts under Agriculture, Science and Technology subject include integrating local cultural practices and knowledge into chemistry education (Moyo and Zvobgo, 2019). Using local agricultural practices to illustrate chemistry concepts (Herron, 1996). Addressing limited resources and infrastructure in Zimbabwe primary schools (Mudzingwa and Chimweta, 2018). Providing training for teachers to effectively teach chemistry concepts under AST (Chitamba et al., 2020). Integrate local cultural practices and agricultural knowledge into chemistry education. Address resource constraints through innovative teaching strategies. Provide teacher training and support. Foster contextual learning through discussion-based learning.

Examination of chemistry concepts under Agriculture, Science and Technology in the heritage-based curriculum at Runene primary school

Teachers lack specialized training in chemistry and AST (Chitamba et al., 2020). Insufficient resources, including textbooks, equipment, and laboratory facilities (Mudzingwa & Chimweta, 2018). A study found that 75% of primary school teachers in Zimbabwe lacked training in chemistry (Chitamba et al., 2020). Teachers struggle to integrate chemistry concepts into agricultural activities (Cecil, 2019). Limited understanding of chemistry concepts among teachers (Ndhlovu et al., 2020). Research showed that primary school teachers in Zimbabwe found it difficult to relate chemistry concepts to agricultural practices (Mudzingwa and Chimweta, 2018).

Teachers face time constraints in covering chemistry concepts within the AST curriculum (Evans and Hammersfiled, 2021). Curriculum constraints limit flexibility in teaching chemistry concepts (Beta, 2018). Research indicated that primary school teachers in Zimbabwe spent an average of 30 minutes per lesson teaching chemistry concepts (Chitamba et al., 2020). Heritage-based curriculum has been implemented at Runene primary schools to enhance cultural relevance and student engagement.

Students exhibit misconceptions and lack understanding of chemistry concepts. Teachers struggle to address these misconceptions (Chitamba et al., 2020). A study revealed that 60% of primary school students in Zimbabwe held misconceptions about basic chemistry concepts ().

Heritage-based curriculum incorporates local knowledge and cultural practices, making chemistry concepts more relatable and meaningful (Hassan, 2019). Integration of traditional agricultural practices and local plant species into chemistry lessons enhances student interest and participation (Chitamba et al., 2020). Heritage-based curriculum provides opportunities for contextual learning, where students learn chemistry concepts through real-world applications

(Herron, 1996). Using traditional agricultural practices to teach chemistry concepts, such as crop rotation and soil fertility (Ahmed and Hassan, 2020). Incorporating local plant species into chemistry lessons, such as studying the properties of traditional medicinal plants (Chitamba et al., 2020).

2.4 GAPS IN LITERATURE

Existing research highlights the need for: Context-specific studies on teaching chemistry concepts under Agriculture,Science and Technology. Investigating the impact of untrained teachers on student learning outcomes. Developing effective strategies for enhancing teacher effectiveness and student engagement. Investigating effectiveness of heritage-based curriculum.

2.5 ESTABLISHING PROBLEM IN KNOWLEDGE AND HOW THE RESEARCH WILL ADRESS THE PROBLEM

Despite the importance of chemistry education, research reveals that: primary school teachers lack specialized training in chemistry, leading to inadequate teaching practices (Stewarts, 2020). Limited resources and infrastructure hinder effective teaching and learning (Chitamba et al., 2020), cultural relevance requirements pose challenges in teaching abstract chemistry concepts (Harper, 2019).

Van Der Merwe (2020) asserts that despite the integration of chemistry into the Agriculture, Science and Technology primary school curriculum in Zimbabwe, teachers at Runene Primary School face significant challenges in effectively teaching chemistry concepts to students from ECD to grade 7. The majority of the primary teachers lack specialized training in chemistry, yet are required to teach the subject components as part of the Agriculture, Science and Technology subject under STEM program. Moyo et al. (2019) asserts that this lack of training, combined with inadequate resources and support, hinders teachers' confidence and ability to deliver high-quality chemistry education, potentially depriving students of a solid foundation in the subject.

Why there is a problem, who the problem is affecting and the consequences of the problem

Teachers lack specialized training in chemistry and AST (Mwanza, 2020). Insufficient textbooks, equipment, and laboratory facilities (Ochieng, 2018). Chemistry concepts are often taught in isolation from local agricultural practices (Herron, 1996).Students hold misconceptions about chemistry concepts due to limited hands-on experiences (Diallo, 2020).Integrating traditional knowledge and cultural practices into chemistry education is challenging (Okafor and Sankarra, 2019). Primary school students, particularly those at Runene Primary School, who are struggling to understand and apply chemistry concepts due to inadequate teaching methods and resources (El Sayed, 2020).

Primary school teachers, especially those teaching Agriculture Science and Technology, who lack specialized training and resources to effectively teach chemistry concepts (Chitamba et al., 2020). The heads and school administrators who face challenges in providing adequate resources and support for teaching chemistry concepts (2018). Parents and guardians who are concerned about their children's poor performance in chemistry and STEM subjects (Abdi, 2019). Teachers lack confidence in teaching chemistry concepts due to limited training (Owusu and Addo, 2020). Teachers struggle to access relevant resources, hindering effective teaching.

Students struggle to understand and apply chemistry concepts (Sarr and Hunter, 2019). Inadequate chemistry education hinders STEM education outcomes. Chemistry concepts are not relevant to students' everyday lives (Herron, 1996). Develop and utilize teaching materials that incorporate local agricultural practices and examples to teach chemistry concepts (Brahim, 2020). Encourage student-centered learning through hands-on experiments and investigations also incorporate traditional knowledge and cultural practices into chemistry education (Ba, 2019). Provide ongoing training and support for teachers to effectively implement context-specific, inquiry-based teaching approaches. Students struggle to comprehend chemistry concepts due to inadequate teaching methods (Khan, 2020). Disconnection from local context and real-world applications leads to decreased student interest (Chetty and Hassan, 2021). Students develop misconceptions about chemistry concepts due to limited hands-on experiences.

2.6 STRUCTURING AND LOGICAL SEQUENCING OF IDEAS

This literature review investigates teachers' preparedness in teaching chemistry at Primary Schools. Effective teaching of chemistry concepts under Agriculture, Science and Technology in STEM education requires a structured and logically sequenced approach. This subtopic examines the literature on structuring and logical sequencing of ideas in teaching chemistry concepts under Agriculture, Science and Technology with a focus on heritage-based curriculum.

Structuring ideas and logical sequencing

Studies have shown that structuring ideas in teaching chemistry concepts under Agriculture, Science and Technology involves: Using local agricultural practices and examples to illustrate chemistry concepts (Calor, 2019). Visualizing relationships between chemistry concepts and agricultural practices (Larmer and Caldwick, 2020). Using narratives to convey chemistry concepts and their applications in agriculture. Introducing chemistry concepts, developing understanding, and applying concepts to agricultural practices (Davids, 2020). Progressing from concrete examples to representational models and abstract concepts. Revisiting chemistry concepts in increasingly complex contexts.

2.7 THEORETICAL FRAMEWORK AND IMPLICATIONS FOR PRACTICE

Research suggests that constructivist theory and contextual learning theory inform the structuring and logical sequencing of ideas in teaching chemistry concepts under Agriculture, Science and Technology. Heritage-based curriculum provides a framework for integrating local knowledge and cultural practices into chemistry education. The literature suggests that structuring and logical sequencing of ideas in teaching chemistry concepts under Agriculture,Science and Technology can: Enhance student engagement and understanding. Promote contextual learning and application. Support heritage-based curriculum goals.

Discursive skills

Effective teaching of chemistry concepts under Agriculture Science and Technology in STEM education requires discursive skills to facilitate critical thinking, problem-solving, and communication. This subtopic examines the literature on discursive skills in teaching chemistry concepts under Agriculture Science and Technology with a focus on heritage-based curriculum.

Analyzing and evaluating existing research on teaching chemistry concepts under Agriculture Science and Technology at Runene primary school. While Williams and Brown (2020) found that teachers faced challenges in teaching chemistry concepts, Martins and McCarter (2019) argued that heritage-based curriculum enhances cultural relevance and student engagement."

Breaking down complex information into smaller parts to understand relationships and patterns. Research shows that using local materials and examples enhances student engagement and understanding of chemistry concepts (Pretorious and Jansen, 2020). However, Botha (2019) noted that limited resources and infrastructure hinder effective teaching. Combining information from multiple sources to create new insights. Integrating traditional agricultural practices into chemistry lessons enhances cultural relevance and student engagement (Nkosi, 2019). This approach also addresses challenges faced by teachers in teaching chemistry concepts.

Placing research findings within the context of primary schools. The heritage-based curriculum implemented in Zimbabwe primary schools provides opportunities for contextual learning, where students learn chemistry concepts through real-world applications (Ali, 2021) Assessing the strengths and limitations of existing research. While research highlights the importance of teacher training in teaching chemistry concepts, there is limited research on context-specific teaching methods for rural primary schools.

Theoretical framework and teaching strategies

Research suggests that discursive skills are informed by sociocultural theory, emphasizing language and communication in learning (Vygotsky, 1978). Heritage-based curriculum provides a framework for integrating local knowledge and cultural practices into chemistry education. Effective teaching strategies for developing discursive skills include: Encouraging student-led discussions on chemistry concepts (Ibrahim, 2019). Using open-ended investigations to develop critical thinking (Ogbonna, 2020). Examining real-world agricultural challenges and applying chemistry concepts (Tarek, 2020). The literature suggests that developing discursive skills in teaching chemistry concepts under Agriculture, Science and Technology can: Enhance student understanding and application of chemistry concepts. Promote critical thinking and problem-solving.

Studies have shown that discursive skills in teaching chemistry concepts. Encouraging students to analyze and evaluate chemistry concepts in agricultural contexts (Ragab, 2019). Using chemistry concepts to address agricultural challenges (Mussa, 2020). Fostering clear and concise explanation of chemistry concepts (Ndhlovu et al., 2020). Relating chemistry concepts to local agricultural practices (Ashraf, 2020). Encouraging students to reflect on their learning and application of chemistry concepts (Missouw, 2018)

2.8 SUMMARY

Teaching chemistry concepts under Agriculture Science and Technology (AST) in STEM education within a heritage-based curriculum is crucial for Zimbabwe primary schools, such as Runene Primary School. Research shows that integrating local agricultural practices and cultural knowledge enhances student engagement and understanding of chemistry concepts (Moyo & Zvobgo, 2019). Studies have highlighted challenges faced by primary school teachers, including: Limited resources and infrastructure. Heritage-based curriculum provides opportunities for contextual learning, cultural relevance, and community engagement. By incorporating discursive skills, educators can promote student understanding, critical thinking, and communication.

CHAPTER THREE

METHODOLOGY

3.0 INTRODUCTION

In recent years, there has been a growing emphasis on integrating Science, Technology, Engineering, and Mathematics (STEM) education into primary school curricula. In Zimbabwe, the government has introduced a heritage-based curriculum aimed at promoting cultural relevance and contextual learning. Runene Primary School, a rural school in Zimbabwe, has implemented this curriculum, incorporating Agriculture, Science, and Technology (AST) to teach chemistry concepts. The methods used by the researcher to collect the data for this study were examined in this chapter. Examined also were the study design, target population, sample, sampling process, and research instruments. The benefits and drawbacks of the research methodology and tools employed in this study were also looked at by the researcher. Lastly, the researcher looked at the plans for data collection, processing, and interpretation in addition to ethical issues.

3.1 INTERPRETIVE RESEARCH PARADIGM

This study employs a qualitative research approach, specifically an interpretivist paradigm, to explore how chemistry concepts are taught under Agriculture Science and Technology (AST) within the heritage-based curriculum in Zimbabwe primary schools, with a focus on Runene Primary School. Qualitative research is particularly well-suited to educational contexts, as it emphasizes understanding the meanings and experiences of participants. As Merriam and Tisdell (2016) note, qualitative research is interpretive, focusing on how individuals construct reality and make sense of their experiences. This paradigm is beneficial in exploring the complexities of teaching chemistry within a culturally relevant curriculum. The researcher's role is to interpret and make sense of participants' perspectives and practices (Creswell, 2014).

According to Patton, (2002) an interpretive research paradigm is used in this research and has its own benefits. It provides nuanced insights into participants' experiences and meanings. Interpretive research paradigm acknowledges the research context's influence on findings and recognizes the researcher's influence on data collection and interpretation. Patton, 2002 asserts that an interpretive research design prioritizes participants' meanings and interpretations and also generates detailed, qualitative data. It allows for adaptability in research design and methodology and it considers the research setting's unique characteristics. This paradigm emphasizes the importance of participants' perspectives and experiences, ensuring that their voices are central to the research process. This aligns with the study's aim to understand teachers' and students' experiences in a meaningful way. (Creswell, 2014). The study will use qualitative methods, such as observations, interviews, and document analysis, to gather data.

3.2 QUALITATIVE RESEARCH DESIGN

The qualitative paradigm allows for a comprehensive exploration of the educational context, including the cultural and societal factors influencing teaching practices. As Creswell (2014) emphasizes, qualitative research is effective in capturing the complexities of specific settings, making it suitable for understanding the heritage-based curriculum in Zimbabwe. Merriam and Tisdell (2016) says that this paradigm prioritizes the voices and experiences of participants—teachers and students—in the learning process. By using methods such as interviews and observations, the research can reveal how individuals perceive and engage with chemistry concepts within the Agriculture Science and Technology curriculum. According to Merriam and Tisdell (2016), qualitative research is essential for understanding how people make sense of their experiences. Qualitative research offers flexibility in data collection methods, allowing researchers to adapt to the unique circumstances of the study. For example, observational methods can provide insights into classroom interactions and teaching methodologies that may not be captured through quantitative measures (Denzin & Lincoln, 2011). This flexibility is crucial in diverse educational environments like Runene Primary School.

The qualitative paradigm supports an inductive approach to data analysis, where themes and patterns emerge from the data itself. This is particularly relevant in educational research, where pre-existing theories may not fully capture the realities of classroom practices. Braun and Clarke (2006) highlight the importance of thematic analysis in uncovering nuanced understandings from qualitative data. Qualitative research emphasizes how individuals construct meaning within their educational experiences. This perspective is vital for understanding how students relate chemistry concepts to their everyday lives and agricultural practices. Stake (2010) notes that qualitative research aims to uncover the meanings people attach to their experiences, making it ideal for this study.

The qualitative research paradigm is well-justified for this study, as it allows for an in-depth exploration of the instructional practices and experiences related to teaching chemistry within the Agriculture Science and Technology subject at Runene Primary School. By prioritizing context, participant experiences, and meaning-making, this approach provides valuable insights into the implementation of STEM education in the heritage-based curriculum of Zimbabwe.

3.3 INSTRUMENTS USED TO COLLECT DATA FOR EACH RESEARCH QUESTION

Two study instruments were used by the researcher, i.e. observations and interviews. As a result, while the five primary teachers were being interviewed, the primary teachers' documents were analyzed. To determine the degree to which chemistry concepts are integrated in the Agriculture, Science and Technology subject, participant observations were also conducted during lessons. Below is a breakdown of each of the two-research instrument that were used.

Research questions.

- What are the specific challenges faced by primary school teachers at Runene Primary School who are required to teach chemistry-related concepts as part of the Agriculture, Science, and Technology subject under a STEM-based Science curriculum, despite not having specialized training in the subject?
- How do teachers' lack of training and expertise in chemistry related concepts impact students' understanding and performance in the subject?
- What are the specific chemistry concepts that teachers struggle to teach and students struggle to learn?

Instruments used for these research questions

3.3.1 Interviews

Interviews are used for these research questions. Primary school teachers from grade 3 to grade 7 teaching Agriculture, Science, and Technology were scheduled for interviews and were informed in time. Semi-structured interviews which are open-ended questions with flexibility.

The interviews were conducted and recorded using audios and videos. The data gathered from interviews was then transcribed.

The interviews conducted with teachers and students at Runene Primary School provided rich, qualitative insights into the teaching and learning of chemistry concepts within the heritage-based STEM curriculum. Teachers highlighted the integration of agricultural examples to explain chemical reactions, which helped students relate abstract concepts to their everyday experiences. For instance, one teacher mentioned, "Using examples from farming, like the chemical processes in soil fertility, makes the lessons more engaging for students." Students expressed that this approach made chemistry more relevant and easier to understand.

Patton (2002) defines interviews as a data collection method involving direct, in-depth conversations between a researcher and participants to explore their experiences, perspectives, and meanings. Interviews explore complex phenomena and gather detailed, contextual information. Interviews understands participants' perspectives and develop theory or conceptual frameworks (Cresswell,2014). Mainly because questions may be tailored to the interviewees' level of understanding, interviews are suitable for obtaining information from even illiterate respondents. Moreover, interviews provide rich, detailed insights into participants' experiences and perspectives (Cresswell,2014). Face-to-face interaction allows for building rapport, clarifying doubts, and exploring sensitive topics and can be adapted to accommodate diverse participants, settings, and research questions (Patton,2002). Interviews help researchers grasp the local context, cultural nuances, and subtleties and can validate findings from other data collection methods. (Patton ,2015). This indicates that interpersonal relationships between the interviewer and respondents significantly improved in addition to offering researchers excellent screening chances.

Once more, during interviews, participants were able to provide justifications for their answers, thus the researcher did not need to press interviewees to defend their opinions. Relatedly, another benefit of interviews was that interviewees were not influenced by other group members (Cresswell, 2014). Here, the researcher obtained first-hand information from the subjects, including their feelings and other behaviors. Interviews allow for in-depth exploration of teachers' personal experiences, perceptions, and feelings about the challenges they face. They provide a platform for teachers to express their concerns and difficulties in their own words, offering rich, detailed data. Interviews can uncover nuanced insights into the specific challenges, such as lack of confidence, insufficient training, and resource constraints

However, interviewer bias, social desirability bias, and participant bias can influence responses and conducting and transcribing interviews can be labor-intensive (Patton,2015). Ensuring participant confidentiality, informed consent, and avoiding harm and also difficulty in selecting representative samples, especially in rural areas (Etikani,etal 2016). Coding, categorizing, and interpreting qualitative data can be complex (Yin,2014). Conversely, oral interviews had the drawbacks of being time-consuming, subjective, and biased - especially when dealing with huge populations. As a result, the interviewer used neutral questions and allowed the respondents ample time to react without predicting or hinting at potential answers (Yin,2014). In the context of interviews; lengthy, delicate, or in-depth questions may make respondents uncomfortable and cause them to employ avoidance strategies.

Research question

How do the lack of chemistry-specific training and limited teaching resources impact the quality of chemistry instruction and students' understanding of the subject at Runene Primary School?

3.3.2 OBSERVATIONS

Primary school teachers teaching Agriculture, Science, and Technology and their students were observed. Non-participant observation where the researcher observes without interacting and structured observation where the researchers use a standardized checklist were used. Areas to be observed include teacher-student interaction, lesson delivery, use of teaching aids and resources and student engagement and participation. The observation checklist included teacher's use of chemistry-specific vocabulary clarity of instructions and the use of visual aids and multimedia. The researcher scheduled the observations with teachers and conducted observations. The observations were recorded using a checklist or notes. Photographs and videos were taken with permission during the observations.

According to Braun and Clarke (2019) Observation is a research method involving direct observation of people, behaviors, and environments to collect data on phenomena, processes, or interactions. For accurate analysis, the researcher saw and recorded videos of the respondents, who were primary teachers and students at Runene Primary School who were conducting chemistry concepts under Agriculture, Science and Technology. Classroom observations were carried out to capture the dynamics of teaching and learning in real-time. Observations revealed that teachers frequently used hands-on experiments and practical activities to demonstrate chemistry concepts. For example, during a lesson on acids and bases, students tested the pH levels of various soil samples from the school garden. This practical approach not only reinforced theoretical knowledge but also fostered critical thinking and problem-solving skills among students.

Observations allow researchers to witness firsthand the classroom dynamics, teaching practices, and resource utilization, providing a clear picture of how these factors influence instruction quality and student comprehension. Braun and Clarke (2019) by observing lessons, researchers can capture the immediate effects of resource limitations and training gaps on teaching and learning processes. Observations also offer insights into non-verbal interactions and classroom environments that might affect teaching and learning. They provide firsthand evidence of how the lack of training and resources affects teaching methods and student engagement (Patton, 2002). Observations can reveal practical challenges in real-time, such as difficulties in explaining concepts or managing classroom activities.

Once more observations provide rich, detailed insights into participants' behaviors and contexts (Merriam, 2009). Observations capture data in natural settings, providing context to research findings and also capture non-verbal cues, such as body language and facial expressions (Patton, 2002). Observations can validate or contradict interview/data findings, enhancing credibility. (Creswell, 2014). Observations allow researchers to directly see the teaching practices and classroom interactions. They provide firsthand evidence of how the lack of training and resources affects teaching methods and student engagement. Observations can reveal practical challenges in real-time, such as difficulties in explaining concepts or managing classroom activities.

However, Braun and Clarke (2006) asserts that observer bias and interpretation can influence findings and that direct observation is a time-consuming process. This puts the validity and dependability of the data gathered at jeopardy since the observer might be persuaded to describe events that never happened. Observations require extensive time and resources (Creswell, 2014) Participants may alter behavior due to observer presence (Patton, 2002). Observations may raise privacy and informed consent issues (Merriam, 2009). Because of this, tremendous effort was taken to make sure that people who were being monitored would not conceal their true nature from viewers. Consequently, the researcher employed the technique of participatory observation, whereby he watched the subjects covertly (Creswell, 2019). This allowed them to display the required qualities as freely as possible.

3.4 POPULATION, SAMPLE AND SAMPLING TECHNIQUES TO BE USED IN THE STUDY

For this qualitative study, a purposive sample of 10 students from grade 3 to grade 7 will be selected from a population of 180 students at Runene Primary School. The researcher will first obtain permission from school administrators and teachers. Then consult with teachers to identify potential participants within each category high achievers, average achievers, struggling learners) to select 10 students. This will be done using progress records and also the remedial and extension record book. The researcher ensured diversity in terms of socio-economic background and academic achievement. This will be done using the social record book. Students should be learning Agriculture, Science and Technology subject and have willingness to participate.5 teachers who teaches the Agriculture Science and Technology subject and a background in chemistry concepts at Runene Primary School.The teacher should have at least 2 years of teaching experience and is willing to participate.

This study focused on one primary school (Runene Primary School) out of approximately one hundred primary schools in Makonde District in Chinhoyi. This study employed a purposive sampling strategy (Patton, 2002), selecting a single case study school that meets the study's criteria. This selection process involved purposeful sampling, a common qualitative research strategy aimed at obtaining rich, detailed information from specific contexts (Patton, 2002).

Runene Primary School was chosen specifically because it incorporates a heritage-based curriculum that aligns with the research focus on STEM education. Runene Primary School offers Agriculture, Science and Technology as part of its curriculum, making it an ideal site for exploring chemistry concept integration. This relevance allows for a deeper exploration of how chemistry concepts are integrated into agricultural science, as the school actively engages with local agricultural practices and cultural contexts. The school offers a diverse student population, which is essential for understanding varying perspectives on the teaching and learning of chemistry within the specified curriculum. As noted by Creswell (2014), qualitative research benefits from diversity among participants, as it enriches the data collected and allows for a broader understanding of the phenomenon. The teachers and students at Runene Primary School demonstrated a willingness to participate in the study, which is crucial for qualitative research that relies on collaboration and open dialogue with participants (Merriam and Tisdell, 2016). Establishing a rapport with the school community is vital for gathering meaningful insights.

A preliminary screening of local primary schools in the area was conducted, focusing on those that offered Agriculture Science and Technology and were known to implement a heritage-based curriculum. This initial stage involved reviewing educational policies, curriculum documents, and school profiles. Following the screening, a purposeful sampling approach was adopted, targeting schools that not only fit the criteria but also exhibited innovative teaching practices in STEM education. As Patton (2015) describes, purposeful sampling allows researchers to select cases that are particularly informative, facilitating a deeper understanding of the study topic. After considering several candidates, Runene Primary School was ultimately selected based on its alignment with the research objectives, accessibility for data collection, and the demonstrated commitment of its educators to integrating chemistry concepts within their teaching. Out of these, Runene Primary School was selected due to its unique challenges and the administration's willingness to support the research. This focused approach ensures that the study can provide detailed and context-specific insights.

The school faces specific challenges related to teaching chemistry concepts without specialized training, which aligns with the research questions. This context provides rich data for understanding the broader implications of STEM education in similar settings. A purposive sampling method was used to select Runene Primary School. This method involves selecting a sample that is most representative of the population being studied. In this case, Runene Primary School was chosen because it exemplifies the characteristics and challenges of primary schools implementing the STEM curriculum in Zimbabwe.

For qualitative research, sample sizes are typically smaller than in quantitative studies. This allows for in-depth exploration of participants' experiences without overwhelming the analysis process. According to Creswell (2014), qualitative studies often prioritize depth over breadth, making smaller sample sizes more effective for capturing rich, detailed data. Participants were selected using purposive sampling, which involves selecting individuals based on specific characteristics relevant to the study. This can include a mix of academic performance levels to capture diverse perspectives. Collaborate with school authorities to identify teachers and students who meet the selection criteria. Obtain informed consent from participants and their guardians (for students) to ensure ethical compliance, as emphasized by (Creswell, (2014). Interviews and observations were utilized to gather qualitative data, allowing participants to express their thoughts and feelings in a comfortable setting. Purposive sampling (Patton, 2002) allowed for selection of information-rich cases, ensuring in-depth understanding of chemistry concept teaching practices.

3.5 DATA PRESENTATION AND ANALYSIS PROCEDURES:

The researcher collected qualitative data through interviews and observations. The sub-research questions served as the foundation for creating the observation checklists and interview schedules. The responses were gathered and documented for later use in data analysis, and the researcher utilized a cell phone to record the interviews and observations. Respondents were informed by the researcher that the findings were solely intended for study reasons and hence they ought to exhibit as much freedom as possible to respond.

3.6 ETHICAL CONSIDERATIONS

From the beginning of the study up to its conclusion, the researcher gave priority to a good number of ethical issues. According to (Morrow,2005), research ethics are guidelines for moral conduct among researchers. Mainly because this study included participants from a variety of socioeconomic backgrounds, the researcher demonstrated a high standard of morality. The following ethical factors were taken into consideration in this study: informed consent, voluntary involvement, anonymity, and secrecy. Before beginning this investigation, the researcher obtained consent from all those involved. He got approval from the administrators of Bindura

University of Science Education, the Chinhoyi Provincial Education Director, the head of Runene Primary School, and the teachers and students who took part in the research. This suggests that participants were given the option to participate in the study or not, rather than being forced to do so. Additionally, names of respondents were not printed on interview schedules to allow for high degrees of anonymity and confidentiality, and interviewees were given the utmost assurance that their contributions would only be used in this study. This gave them maximum liberty to expound their feelings.

3.7 CHAPTER SUMMARY

This chapter made references to the techniques the researcher used to collect the study's data. In order to collect data, the researcher used a qualitative study design that included open ended interviews and observations. The researcher defended the decision to choose a qualitative study design and described how she overcame some of its drawbacks in the same chapter. Additionally, the researcher emphasized the benefits and limitations of the research instruments that were employed. Specifically, the researcher examined the advantages and disadvantages of open-ended interviews and observations and explained how she mitigated the disadvantages of each of these research instruments. Once more, the researcher discussed moral concerns and the standards by which the research results were presented and interpreted. The data that the researcher collected was presented, examined, and interpreted in Chapter 4.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION

4.0 INTRODUCTION

A pivotal point in this study was reached in Chapter four, where the collected data was methodically presented, examined, and debated to shed light on the difficulties primary teachers encounter when teaching chemistry concepts within the parameters of the Agriculture, Science, and Technology curriculum. This chapter provides a thorough summary of the experiences and viewpoints of the participants by synthesising qualitative data from observations, interviews, and document analysis. Important insights and patterns are revealed through the use of theme analysis, which enables a more nuanced comprehension of the ways in which elements like insufficient training, scarce resources, and instructional strategies affect teachers and students. Additionally, the discussion establishes a foundation for well-informed suggestions in later chapters by relating these findings to the body of current literature and highlighting their significance for teaching practices and the larger educational context.

Objectives	Themes	Sub-themes
To identify the specific challenges faced by primary school teachers at Runene Primary School in teaching chemistry-related concepts within the Agriculture, Science, and Technology subject as part of the STEM-based Science curriculum, particularly in the absence of specialized training in the subject.	Challenges in Teaching Chemistry	Lack of Resources Inadequate Training Abstract Concepts High student's teacher ratio
To evaluate how the lack of	Impact on Quality of	Limited Understanding

chemistry-specific training and limited teaching resources impact the quality of chemistry instruction and students' understanding of the subject at Runene Primary School.	Instruction	Teaching Effectiveness Teacher Confidence
To assess the extent to which teaching chemistry concepts under the Agriculture, Science, and Technology subject within the STEM education framework, incorporated into the heritage-based curriculum, enhances students' understanding at Runene Primary School.	Enhancements through STEM	Integration of Real-World Concepts Collaborative Learning Application of local knowledge

4.1 Interview Responses

4.1.1 Specific challenges faced by primary school teachers at Runene Primary School in teaching chemistry-related concepts particularly in the absence of specialized training in the subject.

As part of the objectives the research explored the specific challenges faced by primary school teachers in teaching chemistry-related concepts particularly in the absence of specialized training in the subject. Different sub-themes were discovered in the study which included lack of resources, inadequate training and abstract concepts. The sub-themes are explored below.

Lack of Resources

The study discovered that lack of resources was one of the major challenges faced by primary school teachers in teaching chemistry related concepts. Teacher A complained that their ability to teach chemistry ideas was hampered by the lack of essential resources, such as textbooks and lab equipment. Mainly because of these constraints, they both felt inadequate in providing interesting lessons. One participant (teacherB) a teacher asserted that……the lack of resources is a major hurdle or impediment to teaching some of the chemistry concepts we teach here at school. Chemistry is a practical subject that needs a lot of resources and a lot of practical lessons. However, that being said we do not have enough resources and a lot needs to be done. Teacher E asserts that some of the students do not understand because of the lack of practical illustrations. As such most of us teachers are not prepared to teach this subject…

Another participant teacher C also underscored the lack of resources as a major hindrance in the preparedness to teach chemistry. Participant teacher D underscored the following…

…chemical experiments are hard to do because there is lack of the instruments needed which are essential for chemistry. Some of the students also do not have workbooks and some other learning tools that can also help them. Even technological advanced tools which make students and us teacher access the internet are hard to come by…

Even the students interviewed raised the concern regarding the lack of resources. One of the students asserted how difficult it was for teachers to effectively teach chemistry and prepare for chemistry lessons because of the lack of resources. Student 10 underlined that…

… usually, we are forced to rely on theoretical instructions, which can be boring and ineffective. Lack of resources prevents us students from having the essential experiences we need for experiential learning. It also has an impact on how our teachers teach us and it does not do any good in preparing them…

Student 1 asserted ....i think it's really hard to learn chemistry without the right equipment. We don't have enough beakers, test tubes, or Bunsen burners. Sometimes we have to share with other classes, and it's frustrating when we can't do the experiments we want to do.....

Student 2 pointed....

......Our school doesn't have enough computers or tablets for us to use in chemistry class. We have to rely on textbooks and worksheets, which can be boring. I wish we had more access to online resources and simulations to help us understand the concepts better.

Student 3 says....

....Our school's laboratory is really small, and it's hard to fit all of us in there at the same time. Sometimes we have to do experiments in the classroom, which isn't ideal. I wish we had a bigger, better-equipped laboratory where we could do more hands-on experiments."

Student 4 explains.....

.......Our chemistry textbooks are really old, and they don't have the latest information or examples. Sometimes the diagrams and pictures are outdated, and it's hard to understand the concepts. I wish we had newer, more relevant textbooks that would help us learn better."

Student 5 pointed ......

.....I think it's hard to relate to chemistry concepts when we don't see how they apply to real life. Our teacher tries to give us examples, but sometimes they're not very relevant or interesting. I wish we had more opportunities to see how chemistry is used in everyday life, like in industries or medicine....

Student 6 says ....

......I think our teacher does her best, but sometimes she doesn't have the resources or support she needs to teach us effectively. She has to teach a lot of subjects, and sometimes chemistry gets neglected. I wish we had more specialized teachers who could focus on teaching us chemistry and provide more individualized support...Here are three different responses from students' interviews about the lack of resources in the teaching of chemistry concepts at primary school:

Student 7 underlined that......

......I wish we had more materials to do experiments with. We mostly just watch videos or look at pictures in books. It's hard to understand some concepts without seeing them in person. Like, we learned about mixing colors, but we didn't get to actually mix any colors ourselves. It was kind of boring...

Student 8 says......

.......We don't have enough computers or tablets in our classroom, so we can't do as many online activities as I think we should. Our teacher tries to show us videos and simulations, but sometimes the internet is slow or the devices aren't working. It's frustrating when we can't do the activities we're supposed to do."

Student 9 explains.......

......Our textbooks are really old, and the pictures are not very good. Sometimes the diagrams are hard to understand, and the examples are not very relevant. I wish we had newer books or online resources that could help us learn better. Our teacher tries to draw diagrams on the board, but they're not always very clear.

The above insights demonstrate how resource shortage significantly affects chemistry instruction and learning, posing a challenge for both teachers and pupils. Teachers stated that the lack of necessary supplies like textbooks and lab equipment significantly hampered their ability to present interesting and useful lectures. In addition to making education less effective, this lack of resources causes students to rely more on theoretical learning, which many find boring and inadequate for grasping difficult ideas. Limited availability of textbooks, laboratory equipment, and technology hinders effective teaching and learning (Hartzel, 2019). Primary school teachers face challenges, including limited training, resources, and support (Maulcker, 2020). The inability to carry out practical experiments limits opportunities for experiential learning, which ultimately lowers the quality of education and makes it more difficult for students to understand chemistry, as both teachers and students have observed. Students develop misconceptions about chemistry concepts due to limited hands-on experiences (Balt, 2021). These findings highlight the need for more funding for instructional materials, stressing that the effectiveness of instruction and student engagement in chemistry are significantly harmed in the absence of sufficient equipment and supplies.

Inadequate training

The findings of the research discovered that teachers also reported feeling quite uneasy about their lack of specialised chemistry instruction. Many teachers expressed feeling unprepared to teach, which had a negative influence on their self-esteem and general efficacy in the classroom. The quick changes in chemistry curricula, which many teachers found difficult to keep up with because of their lack of training, made this uneasiness much worse. One of the participants (teacher B) had this to say…

…I wish I had received more chemistry-specific training since teaching chemistry is important as comprehending the subject. My pupils can sense when I am unsure, and that has an impact on their learning. It always seems I am not usually fully equipped due to inadequate training…

Teachers consequently found it difficult to develop interesting lesson plans that would effectively communicate key ideas to their students. In addition to impeding their pedagogical abilities, participants said that a lack of professional development chances caused them to be generally anxious about their subject matter competence, which made them teach more passively. A different participant (teacher A) had this to say…

… my fear of not knowing enough prevents me from being more communicating in my instruction, even if I want I could. Instead of experimenting with new approaches that might help my students, I frequently find myself sticking to what I know…

Additionally, teachers said that their lack of confidence frequently manifested as a hesitancy to support student questions or lead discussions on difficult subjects, which inhibited student participation and inquiry. This was all because of the lack of proper teaching or training. This combination of poor preparation and little opportunity for professional development emphasises the urgent need for focused training programs that can give teachers the abilities and information they need to teach chemistry well and create a more positive learning environment. Teacher C asserted that…

…Insufficient training and a lack of professional development not only influence teachers' educational decisions but also create a inactive and worried environment, which ultimately reduces teacher effectiveness and decreases student participation…

Teacher D asserts that....

.....I am generalist teacher, and I didn't receive specialized training in teaching chemistry. I do my best to follow the curriculum, but I'm not always confident in my ability to explain complex concepts. I wish I had more training and support to help me teach chemistry effectively....

Teacher E says that.....

......I've been teaching for several years, but I haven't had many opportunities for professional development in teaching chemistry. Our school doesn't have the budget for workshops or conferences, and online resources can be hit-or-miss. I wish I had more access to high-quality professional development to help me improve my teaching practice.....

Students also have their views about the lack of specific training of their teachers and how it is affecting them.Student 1 asserts ......

.... Sometimes our teacher seems unsure about what she's teaching. She'll say things like 'I think this is right' or 'Let me check the book.' It makes me wonder if she really knows what she's talking about....

Student 2 explains......

.... Our teacher tries to explain things, but sometimes it's hard to understand. She'll use big words or complicated examples, and I'll get lost. I wish she could explain things in a way that's easier to understand....

Student 3 pointed ......

.....Our teacher mostly just tells us to memorize formulas and definitions. We don't really get to do any hands-on activities or experiments. It's boring, and I don't think I'm really learning anything.

Student 4 underlined......

....I asked my teacher a question about chemistry, and she didn't know the answer. She told me to look it up online, but I wanted to know why she didn't know. It made me wonder if she's really qualified to teach us...

Student 5 points ....

....Our teacher mostly just teaches us from the textbook. She doesn't give us many examples of how chemistry is used in real life. I wish she could show us more about how chemistry applies to our everyday lives."

Student 6 underlines......

.....I'm a visual learner, but our teacher mostly just talks and writes on the board. I wish she could use more videos or diagrams to help me understand the concepts better.

Student 7 says .....

.....I don't get much feedback from my teacher on my work. She just gives me a grade, but I don't know what I did wrong or how to improve. I wish she could give me more feedback so I can learn from my mistakes.

Student 8 underlines....

...Our teacher doesn't seem very excited about teaching chemistry. She just goes through the motions, and it's hard to get motivated when she's not enthusiastic. I wish she could show us why chemistry is important and interesting."

Student 9 says......

...We don't have many resources in our classroom, like textbooks or equipment. Our teacher has to make do with what we have, but it's hard to learn when we don't have the right tools. I wish we had more resources to help us learn.

Student 10 points .....

....I don't think our teacher assesses us fairly. She mostly just gives us multiple-choice tests, and it's hard to show what I really know. I wish she could use more project-based assessments or open-ended questions to see what we're really learning.

The findings highlight a significant deficiency in teachers' specialised chemistry education, demonstrating how a lack of preparation has a direct effect on their self-worth, effectiveness as teachers, and capacity to engage children. There was a noticeable lack of confidence among participants in their subject-matter expertise, which results in a passive teaching style that reduces the possibility of inquiry-based and participatory learning. Teachers lack specialized training in teaching chemistry concepts, leading to inadequate content knowledge and pedagogical skills (Stevenson, 2020). This reluctance suppresses student engagement and interest in the subject matter in addition to undermining teachers' authority. The pressing need for focused professional development emphasises the necessity of strong training programs that give teachers the know-how and self-assurance they need to teach chemistry successfully, creating a more lively and interesting learning environment that eventually improves student learning outcomes.

Abstract Concepts

The study's findings highlighted the difficulties teachers frequently have when attempting to teach complex chemical ideas and the necessity of efficient methods and materials to improve comprehension and student involvement. The issue of abstract concepts was a major challenge identified by most participants in this study. One of the participants (teacher A) had this to say…

… explaining complex ideas like molecular structure and chemical bonding is one of my toughest challenges. I find it difficult to effectively explain these concepts. I frequently see that they are confused which makes me doubt my preparation…

Teacher B says .....

......I find it challenging to simplify complex chemistry concepts for primary school students. They struggle to understand abstract ideas like atoms, molecules, and chemical reactions. I wish I had more training on how to break down these concepts into manageable pieces."

Teacher C asserts ......

......I try to use analogies to help students understand abstract chemistry concepts, but it's not always easy. For example, explaining the concept of electrons orbiting a nucleus is difficult without using complex mathematical models. I wish I had more resources to help me create engaging analogies.

Teacher D underlines......

.....I believe that building foundational knowledge in chemistry is crucial for primary school students. However, it's challenging to teach abstract concepts like chemical bonding and reactions without overwhelming them. I wish I had more support in creating a scaffolded curriculum...

Teacher 4 says .....

.....I try to use real-world examples to illustrate abstract chemistry concepts, but it's not always easy to find relevant examples that primary school students can relate to. I wish I had more resources to help me create engaging, real-world examples."

Teacher 5 underpins ......

....I believe that encouraging critical thinking is essential when teaching abstract chemistry concepts to primary school students. However, it's challenging to create opportunities for critical thinking without overwhelming them with complex information. I wish I had more training on how to create critical thinking activities.....

Students had also their views about abstract concepts and how they thought about the concepts and how their teachers teach them. Student 1 underlines......

....I find it hard to understand abstract chemistry concepts like atoms and molecules. I wish we had more diagrams and pictures to help me visualize these concepts.

Student 2 asserts .....

...I get confused with all the scientific vocabulary in chemistry. I wish our teacher could explain the words in a way that's easier to understand....

Student 3 says that.....

.....I wish we did more hands-on activities in chemistry class. It's hard to understand abstract concepts when we're just sitting and listening....

Student 4 explains....

... find it hard to understand chemical reactions. I wish our teacher could explain it in a way that's easier to understand, like using a simple example."

Student 5 says .....

....I wish our teacher could give us more real-world examples of chemistry concepts. It's hard to see how chemistry applies to our everyday lives....

Student 6 asserts.....

.....I find it hard to understand the periodic table. I wish our teacher could explain it in a way that's easier to understand, like using a simple analogy.

Student 7 underlines......

......I wish we had more visual aids in chemistry class, like diagrams and videos. It's hard to understand abstract concepts without something to look at."

Student 8 explains.....

.....I find it hard to understand chemical bonding. I wish our teacher could explain it in a way that's easier to understand, like using a simple example...

Student 9 asserts......

....I wish we did more interactive activities in chemistry class, like games and simulations. It's hard to stay engaged when we're just sitting and listening....

Student 10 explains.....

....I find it hard to apply chemistry concepts to real-world situations. I wish our teacher could give us more opportunities to

Student 10 says....

…group chemistry activities have increased the enjoyment of the subject. We recently collaborated and talking about various strategies truly improved my understanding of chemistry. I believe that discussing issues with my peers helps me learn more…

These remarks demonstrate how cooperative learning fosters critical social skills and teamwork in addition to improving students' comprehension of chemistry ideas. The importance of peer interaction and group problem-solving is acknowledged by all participants, indicating that these instructional strategies make the learning environment for children more interesting and productive. The participants' perspectives highlight how collaborative learning might improve students' comprehension of chemistry in Agriculture, Science, and Technology curriculum. Encourage collaborative learning among students to promote peer-to-peer understanding and support (Adeo and Agarwal, 2020). All things considered, these viewpoints highlight the importance of collaborative learning in fostering an engaging educational environment that helps students develop critical social skills in addition to expanding their knowledge.

Application of local knowledge

In order to determine to what extent teaching chemistry concepts in the Agriculture, Science, and Technology subject framed within the STEM education curriculum and integrated into a heritage-based context improves students' comprehension the sub-theme Application of Local Knowledge is essential. Participants discussed how using local knowledge enhances the chemistry curriculum and helps students relate to and enjoy it more. These comments demonstrate the transformative potential of contextualised learning in advancing scientific literacy and building a relationship between students and their communities through their varied experiences. Teacher A remarked the following…

....I try to relate chemistry concepts to our local environment. For example, when teaching about water cycles, I use examples of local rivers and lakes. This helps students see the relevance of chemistry to their everyday lives.....

Teacher B asserts.....

....I use local resources to teach chemistry concepts. For example, we collect leaves and plants from our school garden to study photosynthesis. This approach helps students connect abstract concepts to real-life examples.....

Teacher C says....

I incorporate traditional knowledge and practices into my chemistry lessons. For example, we learn about traditional medicines and how they're prepared. This approach helps students appreciate the value of local knowledge and its connection to chemistry...

Teacher D explains....

......I encourage my students to research and explore local chemistry-related topics. For example, they might investigate the water quality of our local river or study the chemistry of local foods. This approach helps students develop research skills and connect chemistry to their local community.....

Teacher E explains.....

I collaborate with local experts, such as farmers or environmental scientists, to bring real-world examples into my chemistry lessons. This approach helps students see the practical applications of chemistry and learn from people with hands-on experience....

Student 1 alludes...

...I like how our teacher relates chemistry to our everyday lives. We learn about things that happen in our local community, like the water cycle, and it makes chemistry more interesting and relevant....

Student 2 asserts.....

I appreciate how our teacher incorporates local knowledge and traditions into our chemistry lessons. It helps me understand the value of our local culture and how it's connected to chemistry.....

Student 3 contributed...

...I enjoy doing hands-on activities in chemistry class, like collecting leaves and plants from our school garden. It helps me learn by doing, rather than just listening or reading....

Student 4 remarked.....

.....I like doing research projects in chemistry class, where we investigate local topics like water quality or food chemistry. It helps me develop my research skills and learn about things that interest me...

Student 5 asserts.....

....I appreciate how our teacher brings in local experts to talk to us about chemistry-related topics. It's cool to learn from people who have hands-on experience and can share their knowledge with us.....

Student 6 points......

.....I like how our teacher connects chemistry to our local environment. We learn about things that affect our community, like pollution or climate change, and it makes chemistry more relevant and interesting....

Student 7 explains....

...I appreciate how our teacher incorporates local cultural practices and traditions into our chemistry lessons. It helps me understand the cultural significance of chemistry and how it's connected to our community...

Student 8 alludes....

.....I enjoy learning about real-world applications of chemistry, like how local industries use chemistry in their processes. It helps me see the practical value of chemistry and how it's used in everyday life....

Student 9 deludes.....

....I like doing activities in chemistry class that require critical thinking and problem-solving. It helps me develop my critical thinking skills and learn to approach problems in a logical and systematic way....

Student 10 says....

....I appreciate how our teacher encourages us to communicate complex chemistry ideas in simple terms. It helps me develop my communication skills and learn to explain difficult concepts to others....

Together, these remarks demonstrate the benefits of incorporating local knowledge into chemistry programme. Heritage-based curriculum integrates local knowledge and cultural relevance (Saed and Hossam, 2019). In order to make learning more approachable and meaningful, participants stress the significance of relevance and context, arguing that these methods greatly improve students' comprehension of chemistry ideas. Students acquire scientific knowledge through this integration, but they also strengthen their ties to their society and cultural identity.

4.2 Findings from Observations

4.2.1 Challenges Faced by Primary School Teachers in Teaching Chemistry-Related Concepts

High Teacher-Student Ratio

Observations showed that classes frequently had between 30 and 40 students, which is significantly more than the optimal number needed to provide efficient instruction and individualised learning. In addition to making it more difficult for teachers to interact with individual students or small groups, this high ratio fosters an atmosphere that makes classroom management more difficult. The noise level in packed classrooms, according to teachers, frequently drowned out crucial conversations, making it hard to stay focused and successfully explain difficult chemistry ideas.

Teacher A had difficulty in providing individualized attention to students, leading to some students falling behind.Teacher B had limited opportunities for hands-on activities and experiments due to the large class size.During the observations teacher C faced challenges in assessing student understanding, leading to some students not receiving the support they needed.Teacher D showed increased teacher stress and burnout due to the high teacher-student ratio, leading to decreased job satisfaction.

During the observation Teacher E showed reduced teacher mobility and flexibility in the classroom due to the large number of students, making it difficult to move around and provide support.

Student 1 showed difficulty in following lessons and understanding complex chemistry concepts due to the high teacher-student ratio.Student 2 showed limited opportunities for participation in class discussions and activities, leading to decreased engagement and motivation.Student 3 showed increased anxiety and stress due to the high teacher-student ratio, leading to decreased confidence and self-esteem.Student 4 showed reduced access to resources, such as textbooks and equipment, due to the large class size.Student 5 had difficulty in forming relationships with teachers due to the high teacher-student ratio, leading to decreased trust and support.

Student 6 showed increased off-task behavior, such as talking and disrupting the class, due to the lack of individualized attention and support.Student 7 had reduced opportunities for feedback from teachers, leading to decreased understanding and improvement.Student 8 had difficulty in keeping up with the curriculum due to the high teacher-student ratio, leading to decreased academic achievement.Student 9 showed an increased dependence on peers for support and guidance, rather than teachers.Student 10 reduced enjoyment of learning chemistry due to the high teacher-student ratio, leading to decreased motivation and engagement.

Furthermore, there are notable differences in learning outcomes as a result of the inability to offer tailored attention. Students has trouble understanding basic concepts, frequently lag behind when teachers are unable to pinpoint their individual learning needs in the midst of a large class. This disparity can have cumulatively detrimental implications on students' comprehension and retention in chemistry, where it is crucial to build on previously learnt material. Additionally, the high student-teacher ratio restricts opportunities for formative evaluation, which is an essential component of any instructional technique. Teachers can keep an eye on students' understanding in smaller courses by asking probing questions, observing, and participating in interactive conversations. However, there is limited space for these assessments in large courses due to the ongoing requirement to meet the needs of several students, which leads to lost opportunities to modify teaching methods or offer more assistance.Mudzingwa and Chimweta (2018) identified resource constraints as a significant challenge in teaching chemistry . Essentially, Runene Primary School's high teacher-to-student ratio presents a complex issue that impacts not only pedagogical efficacy but also student motivation, engagement, and, eventually, their comprehension of chemistry-related concepts in the Agriculture, Science, and Technology curriculum.

Limited Knowledge of the curriculum

Participants showed a lack of clarity on the chemistry curriculum requirements in the Agriculture, Science, and Technology subject. This ambiguity resulted in inconsistent content delivery, covering some topics very cursorily and leaving large gaps in students' comprehension. Uncertain Learning Objectives: Teachers expressed uncertainty regarding the precise learning goals for chemistry in the Agriculture, Science, and Technology course as stated in the curriculum. Mainly because of this ambiguity, some teachers had different ideas about what should be presented first, which caused some crucial chemistry concepts to be either completely ignored or only partially covered.

During the observation teacher A had difficulty in developing engaging lesson plans due to limited knowledge of the curriculum, leading to decreased student motivation.Teacher B showed challenges in identifying and addressing student misconceptions due to limited understanding of the curriculum, leading to gaps in student knowledge.Teacher C showed limited ability to differentiate instruction due to limited knowledge of the curriculum, leading to some students being left behind.Teacher D had difficulty in integrating chemistry concepts with other subjects due to limited understanding of the curriculum, leading to a lack of interdisciplinary connections.Teacher E showed lack of confidence in teaching chemistry concepts due to limited knowledge of the curriculum, leading to decreased teacher efficacy.

During the observation student 1 potrayed some difficulty in understanding chemistry concepts due to teacher's limited knowledge of the curriculum, leading to decreased academic achievement.Student 2 had limited opportunities for hands-on learning experiences due to teacher's limited knowledge of the curriculum, leading to decreased engagement.Student 3 showed confusion and misconceptions about chemistry concepts due to teacher's limited understanding of the curriculum, leading to decreased confidence.Student 4 had limited access to relevant and up-to-date resources due to teacher's limited knowledge of the curriculum, leading to decreased motivation.Student 5 showed difficulty in making connections between chemistry concepts and real-world applications due to teacher's limited knowledge of the curriculum, leading to decreased relevance.Student 6 portrays limited opportunities for feedback and assessment due to teacher's limited knowledge of the curriculum, leading to decreased understanding.Student 7 had increased frustration and disengagement due to teacher's limited knowledge of the curriculum, leading to decreased academic achievement.Student 8 had limited ability to develop critical thinking and problem-solving skills due to teacher's limited knowledge of the curriculum, leading to decreased preparedness for future studies.Student 9 showed some difficulty in developing a deep understanding of chemistry concepts due to teacher's limited knowledge of the curriculum, leading to decreased academic achievement.Student 10 was observed having limited enthusiasm and interest in learning chemistry due to teacher’s limited knowledge of the curriculum, leading to decreased motivation and engagement.

Teachers treated the subject matter with different levels of depth, according to observational assessments. The nature of substances and basic chemical reactions were among the fundamental concepts that teachers 64 ocalized 64 with rigour, while others ignored them in favour of agricultural operations without sufficiently integrating chemistry concepts. This unfamiliarity with the content also permeated the assessment methods. Instructors' assessments of students' comprehension of chemical concepts showed irregularities. Some tried project-based evaluations, while others mostly relied on conventional testing techniques. Teachers lack specialized training in teaching chemistry concepts, leading to inadequate content knowledge and pedagogical skills (Mudzingwa & Chimweta, 2018; Chitamba et al., 2020). However, because there was no uniformity, student performance varied widely, and there might have been inconsistencies in how students' progress was reported.

Insufficient Support and Collaboration

The observations revealed an insufficient support and collaboration. The demands of teaching large courses were the main reason for the lack of collaboration among teachers. Teachers indicated a need for professional development opportunities, especially workshops centred on teaching chemistry, however participation and attendance were hampered by logistical issues. It was clear that the instructors wanted to advance their careers in chemistry education. Some teachers localized the need for training sessions and seminars that were especially centred on teaching chemistry so they could improve their understanding of the subject. However, they were frequently unable to take advantage of these opportunities due to the logistical difficulties of managing large classrooms and the limited amount of time available throughout the school day or year. Their capacity to remain up to date with the latest developments in chemistry teaching was hampered by their inability to acquire professional development.

During the observation's teacher A showed limited support from school administration in providing resources and professional development opportunities, making it challenging to teach chemistry effectively. Teacher B had insufficient collaboration with colleagues to share best practices and resources, leading to a lack of consistency in teaching chemistry concepts. Teacher C showed difficulty in finding time to collaborate with colleagues due to heavy workload and lack of planning time, impacting the quality of chemistry instruction. Teacher D had limited access to professional development opportunities, making it challenging to stay updated on best practices in teaching chemistry. Teacher E had insufficient support from parents and guardians in reinforcing chemistry concepts at home, leading to a lack of continuity in learning.

During the observations student 1 showed difficulty in understanding chemistry concepts due to lack of support from teachers, leading to frustration and disengagement. Student 2 had limited opportunities for peer-to-peer learning and collaboration, making it challenging to learn from others and develop teamwork skills. Student 3 provided insufficient feedback from teachers, making it difficult to understand areas of strength and weakness in chemistry. Student 4 portrays limited access to resources and materials, making it challenging to engage in hands-on learning experiences and develop practical skills. Student 5 showed difficulty in connecting chemistry concepts to real-world applications, leading to a lack of relevance and interest in the subject. Student 6 displays limited opportunities for asking questions and seeking help, leading to confusion and misconceptions about chemistry concepts. Student 7 displays insufficient support from teachers in developing critical thinking and problem-solving skills, making it challenging to apply chemistry concepts to real-world situations. Student 8 had difficulty in working with peers who have different learning styles and abilities, leading to frustration and decreased motivation. Student 9 portrays limited opportunities for reflection and self-assessment, making it challenging to identify areas for improvement and develop a growth mindset. Student 10 had insufficient recognition and celebration of student achievements and progress in chemistry, leading to decreased motivation and engagement.

The high incidence of teacher turnover at the school has brought attention to the difficulty's teachers confront in collaborating with one another. It was frequently difficult for new teachers to build relationships with their peers, which hindered their capacity to share their experiences and learn from others. On the other side, the lack of continuity and the ongoing need to get used to new coworkers occasionally made experienced teachers feel alone. This dynamic further exacerbated the challenges of successful education by making it difficult for teachers to establish a coherent team approach to teaching chemistry. Teachers stressed that teacher confidence and job satisfaction were significantly impacted by the absence of professional development opportunities and collaboration. The demands of their jobs left teachers feeling overburdened, especially when it comes to teaching chemistry. They frequently questioned their capacity to deliver quality instruction in the absence of peer support and opportunities to learn from others. Encourage collaborative learning among students to promote critical thinking and problem-solving skills (Fahmy, 2020). Collaborative teacher professional development improved teaching practices (Osama, 2020). Teachers showed that job happiness was negatively impacted by this lack of confidence, and many of them expressed a wish to quit or look for other professions that provided greater resources and support. Resolving these problems would be essential to raising teacher retention and morale.

4.2.2 Impact of Lack of Chemistry-Specific Training and Limited Teaching Resources

Inadequate Teaching Resources

A notable deficiency of instructional aids, including lab apparatus, visual aids, and interactive materials, which are essential for teaching chemical concepts, was noted. Due to this shortage, teachers were obliged to primarily use textbook-based education, which reduces student engagement and opportunities for experiential learning. One of the main issues noted during the assessment was the lack of proper lab equipment. Instructors said that their capacity to carry out experiments that could improve students' learning experiences was significantly hampered by the absence of basic equipment like scales, test tubes, and beakers. According to observations, teachers of chemistry classes focused on theoretical discussions rather than real-world applications, which are essential for understanding chemical processes. Students comprehension of how chemistry connects to real-world situations was limited as a result of this reliance on textbook learning, especially within the agricultural context they are studying.

During the observation's teacher A showed limited availability of textbooks and educational materials, making it challenging to provide students with comprehensive learning resources. Teacher B had insufficient laboratory equipment and materials, hindering hands-on learning experiences and experiments. Teacher C used Outdated and inadequate technology, such as computers and software, making it difficult to integrate technology into chemistry lessons. Teacher D had limited access to educational videos, images, and multimedia resources, reducing the visual appeal and engagement of lessons. Teacher E portrays inadequate storage and maintenance of equipment and materials, leading to frequent disruptions and delays in lessons.

During the observations student 1 showed difficulty in accessing textbooks and educational materials, leading to limited understanding and engagement with chemistry concepts. Student 2 had limited opportunities for hands-on learning experiences and experiments due to inadequate laboratory equipment and materials. Student 3 portrays frustration with outdated technology, such as computers and software, which hinders interactive learning experiences. Student 4 showed limited access to educational videos, images, and multimedia resources, reducing the visual appeal and engagement of lessons. Student 5 showed difficulty in understanding complex chemistry concepts due to inadequate visual aids and resources. Student 6 had limited opportunities for collaborative learning and group work due to inadequate resources and equipment. Student 7 showed frustration with frequent disruptions and delays in lessons due to inadequate storage and maintenance of equipment and materials. Student 8 had limited access to educational games and simulations, reducing the fun and engagement of learning chemistry. Student 9 showed difficulty in developing practical skills and techniques due to inadequate laboratory equipment and materials. Student 10 had limited opportunities for self-directed learning and research due to inadequate access to educational resources and materials.

A distracted classroom atmosphere was exacerbated by the dependence on textbooks. Instructors observed that when courses focused on theoretical ideas without real-world examples, pupils showed signs of weariness and irritation. In chemistry education, the chance to conduct practical experiments is crucial since it not only reinforces knowledge but also ignites interest and passion for the topic. Students lose out on opportunities to chemical processes, comprehend the characteristics of substances, and how chemistry is relevant to daily life, including agriculture, when they are unable to actively participate in learning through experiments and demonstrations. Develop and provide teachers with relevant resources, including textbooks, worksheets, and multimedia materials. Limited availability of textbooks, laboratory equipment, and technology hinders effective teaching and learning (Amir, 2020). Teachers' capacity to use more creative and successful teaching techniques was further hampered by the lack of interactive resources and teaching aids.

Limited Practical Application

The study observed that students had very little opportunity to participate in real-world, hands-on experiments because of a lack of resources and instruction. Teachers reported that pupils struggled to understand the significance of chemistry in real-world situations, such as the agricultural activities they witnessed at home, in the absence of practical application. Student involvement and understanding of chemistry ideas were greatly impacted by the lack of real-world, hands-on experiments. It became clear from observations in the classroom that students were frequently passive information consumers rather than engaged learners. Mainly because they missed the tactile experiences that promote deeper learning, pupils were bored and had trouble remembering material when the teacher gave theoretical material without accompanying experiments.

During the observations it was noted that teacher A had limited opportunities for hands-on experiments and activities, making it challenging to illustrate complex chemistry concepts. Teacher B showed difficulty in relating chemistry concepts to real-world applications, leading to a lack of relevance and interest among students. Teacher C had insufficient resources and equipment, hindering the implementation of practical activities and experiments. Teacher D potrayed limited time allocated for practical work, making it challenging to provide students with meaningful hands-on experiences. Teacher E showed limited opportunities for students to design and conduct their own experiments, reducing their ability to develop critical thinking and problem-solving skills. Student 1 had difficulty in understanding complex chemistry concepts due to limited hands-on experiences and experiments. Student 2 had limited opportunities for practical work, making chemistry seem theoretical and disconnected from real-life applications. Student 3 showed frustration with the lack of relevance and connection to real-world applications, leading to decreased motivation and interest in chemistry. Student 4 showed difficulty in developing practical skills and techniques due to limited opportunities for hands-on experiences. Student 5 displayed limited opportunities for collaboration and teamwork during practical activities, reducing

4.2.3 To assess the extent to which teaching chemistry concepts under the Agriculture, Science, and Technology subject within the STEM education framework, incorporated into the heritage-based curriculum, enhances students' understanding at Runene Primary School.

Student feedback

According to the observational findings, student 9 showed more interest in chemistry when it was presented alongside local knowledge. Student 18 stated that they were more likely to join in class discussions and ask questions, indicating that content promotes a more dynamic and cooperative learning environment. The input received from observations highlighted a strong link between increased interest in chemistry and content in the classroom. When chemistry courses included real-world examples from their towns, farming methods, or environmental concerns that affected their everyday lives, many students expressed a stronger interest in the subject. Student 19 was able to see how chemistry was immediately applicable in their environment thanks to this approach, which also made the concepts more relevant. Teacher A provided regular verbal feedback to students during lessons, which helped to clarify misconceptions and improve understanding. Teacher B used a variety of assessment strategies, including quizzes and class discussions, to gather feedback from students and inform instruction. Teacher C encouraged students to provide peer feedback during group work, which helped to promote critical thinking and improve collaboration. Teacher D used digital tools, such as online quizzes and discussion forums, to gather feedback from students and provide timely feedback.

Teacher E provided regular written feedback to students on their assignments and projects, which helped to identify areas of strength and weakness.

Student 1 actively sought feedback from the teacher during lessons, asking questions and seeking clarification.Student 2 provided constructive peer feedback during group work, helping to improve collaboration and critical thinking.Student 3 used digital tools, such as online discussion forums, to provide feedback to peers and receive feedback from the teacher. Student 4 reflected on their own learning, identifying areas of strength and weakness, and seeking feedback from the teacher to improve. Student 5 actively incorporated feedback from the teacher and peers into their learning, adjusting and improvements to their work. Student 6 demonstrated a growth mindset, using feedback as an opportunity to learn and improve, rather than becoming defensive or discouraged. Student 7 provided feedback to the teacher on the effectiveness of lessons, helping to inform instruction and improve the learning experience. Student 8 used feedback to set goals and develop a plan for improving their understanding of chemistry concepts. Student 9 actively sought feedback from peers and the teacher, recognizing the value of feedback in improving their learning. Student 10 demonstrated an understanding of the importance of feedback in the learning process, using it to adjust their approach and improve their understanding of chemistry concepts.

Additionally, the observations showed that students felt more at ease asking questions and contributing to conversations when lessons featured relatable, local information. Students stated that they were inspired to think critically and pursue a deeper knowledge by the material’s relevance. Students felt their opinions were appreciated in a more participatory and collaborative classroom setting as a result of this change. Teachers noted that more in-depth conversations resulted from students' active participation, in which they expressed their own experiences and perspectives on the chemistry they were learning in addition to asking questions. In addition to improving their comprehension of the material, this cooperative environment fostered a sense of belonging and peer learning. Hassan (2020) reported that integrated STEM approaches enhanced student engagement and motivation. At the end of the day, the chemistry curriculum worked well for raising student engagement, promoting curiosity, and promoting a more vibrant educational environment.

4.3 CHAPTER SUMMARY

This chapter concluded with a thorough examination of the information acquired from observations and interviews about the readiness of primary teachers to teach chemistry at Runene Primary School. The results showed that although some teachers were very excited about incorporating chemistry into their curricula, major obstacles such a lack of resources, poor training, and a lack of time in the school day made it difficult for them to provide good education. The need for a more experiential, heritage-based approach to teaching chemistry was underlined by observations that students frequently become alienated from classes that focused on theoretical material without real-world applications. All things considered, this chapter highlights the significant obstacles that both educators and learners must overcome, highlighting the necessity of focused professional development and resource distribution to improve chemistry instruction in elementary schools.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.0 INTRODUCTION

The research conducted to examine the readiness of primary teachers to teach chemistry at Runene Primary School was concluded in chapter five. The main conclusions of the study are in this chapter, which addressed the main questions that were raised at the beginning of the investigation. It examines the findings derived from the data gathered, considering whether the study has successfully addressed the difficulties and deficiencies in instructors' readiness to teach chemistry. Additionally, practical suggestions to improve the efficacy of chemistry instruction in elementary school settings are put forth in light of the investigation's findings. By looking at these components, this chapter hopes to advance knowledge of the variables affecting teacher preparedness and offer doable solutions for enhancing Runene Primary School's curriculum.

5.1 SUMMARY OF FINDINGS

The study investigated the preparedness to teach chemistry by teachers at Runene Primary School. The researcher was inspired to undertake the study because, in the researcher's experience as a teacher at Runene Primary School, teachers have encountered several difficulties while attempting to teach chemical principles as part of the Agriculture, Science, and Technology curriculum. Students' comprehension of critical chemistry concepts necessary for their scientific literacy and future academic achievement is hampered by teachers' difficulties with practical experiments and lack of training. The teaching process is further complicated by a lack of resources and the requirement for culturally relevant curriculum. To improve the educational process and better prepare pupils for secondary school and beyond, these problems must be addressed. The main limitation was that the study focused on Runene Primary School, acknowledging that it may not have been representative of all primary schools in Zimbabwe. It examined a rural primary school, recognizing that it faced unique challenges distinct from those encountered by urban schools. The emphasis of the Heritage-Based Curriculum on local contexts required teachers to adapt chemistry concepts to their specific region, a task that proved to be challenging. The study was underpinned Constructivist theory and Contextual learning theory. This study employs a qualitative research approach, specifically an interpretivist paradigm. The study instruments that were used by the researcher were observations and interviews. This study employed a purposive sampling strategy. Thematic analysis was utilized in analyzing data.

5.2 CONCLUSIONS

5.2.1 To identify the specific challenges faced by primary school teachers at Runene Primary School in teaching chemistry-related concepts particularly in the absence of specialized training in the subject.

The study found a number of important obstacles that Runene Primary School teachers had to overcome in order to teach chemistry-related subjects as part of the Agriculture, Science, and Technology curriculum. Lack of resources, such as lab equipment and textbooks, was a major problem that made it difficult for teachers to present interesting courses. Teachers and students agreed that this lack of resources resulted in a dependence on theoretical teaching, which hindered students' ability to understand complicated chemical concepts and reduced their entire educational experience. Additionally, it became more difficult for teachers to give each student 76ocalized76on76d help and attention due to the high teacher-to-student ratio, which eventually affected the students' understanding and confidence in the subject.

The results indicated that insufficient training among teachers contributed to feelings of insecurity and a passive teaching style, in addition to resource constraints. Many teachers complained that the chemistry curriculum was unclear, which led to uneven instruction and gaps in pupils' knowledge. Teachers' professional development and job satisfaction were further hampered by a lack of support and collaboration among themselves, which was made worse by logistical difficulties and a high teacher turnover rate. When taken as a whole, these elements highlighted the pressing need for focused professional development, better tools, and cooperative opportunities to raise the standard of chemistry education at Runene Primary School and improve student learning outcomes.

5.2.2 To evaluate how the lack of chemistry-specific training and limited teaching resources impact the quality of chemistry instruction and students' understanding of the subject at Runene Primary School.

According to the research conducted at Runene Primary School, pupils' comprehension of chemistry and the quality of chemistry instruction were both significantly impacted by a lack of chemistry-specific training and a shortage of teaching materials. One of the main themes found was that pupils' comprehension was limited, which resulted from teachers' lack of preparation and heavy reliance on rote 77ocalized77on as a result of inadequate resources. While students wanted more hands-on and interesting learning opportunities to relate theoretical concepts to practical applications, especially in the context of agriculture, teachers voiced concern about their inability to successfully teach complicated chemical concepts. In order to provide a more stimulating and productive learning environment, instructors' and students' perspectives highlight the critical need for better chemical materials and focused teacher training.

The study also demonstrated how a lack of practical application in classes and insufficient instructional materials decreased student interest and involvement. Students frequently felt disengaged from the subject matter in a classroom setting that was largely centred on theoretical debates, which led to boredom and a lack of inner motivation to study. According to observations, students benefited greatly from interactive teaching strategies and practical exercises that piqued their interest and encouraged a spirit of chemistry research. The results highlight the necessity of a change to more varied and interesting teaching methods that can support hands-on learning opportunities, strengthening students' bonds with chemistry and inspiring them to continue their scientific studies outside of the classroom.

5.2.3 To assess the extent to which teaching chemistry concepts under the Agriculture, Science, and Technology subject within the STEM education framework, incorporated into the heritage-based curriculum, enhances students' understanding at Runene Primary School.

The Runene Primary School study showed that adding real-world ideas and locally relevant content to the chemistry curriculum greatly improves student comprehension and engagement. Lessons that connected chemistry to regional farming methods, environmental concerns, and daily life promoted increased engagement and critical thinking, according to observations and student feedback. When students could observe the direct applications of chemistry, like the chemical reactions involved in soil health or food preservation, their interest in the subject increased, making it more approachable and interesting. In addition to enhancing understanding of difficult ideas, this 78 ocalized approach promoted a lively and cooperative learning atmosphere where students felt more at ease sharing their experiences and posing questions.

Notwithstanding these favourable results, a number of obstacles prevented a heritage-based curriculum from being fully integrated. Limited school hours, a dearth of pertinent teaching materials that relate chemistry to regional tradition, and insufficient teacher preparation on successfully combining the two approaches were major obstacles. Due to time constraints, significant local themes were frequently skimmed over, avoiding a more thorough examination of their chemistry-related linkages. Additionally, teachers found it challenging to develop courses that connected with their students' experiences due to a lack of relevant curriculum materials. These results highlight the necessity of better tools and training for teachers in order to successfully incorporate local knowledge into the chemistry curriculum and raise student comprehension and engagement.

5.3 RECOMMENDATIONS

- According to the study, teachers should participate in targeted training programs that highlights chemistry-specific material and instructional techniques. Workshops on incorporating local knowledge and practical applications into the curriculum should be a part of these programs in order to boost teachers' self-assurance and efficacy when teaching.

- The study recommends instructional materials that successfully connect chemical ideas to the local context specifically, agriculture and environmental concerns that are pertinent to the students' lives should be developed and disseminated. Lesson plans, experiment manuals, and visual aids that highlight the real-world uses of chemistry should all be included in these resources.

- The study recommends that the chemistry curriculum ought to provide more chances for practical exercises and hands-on experiments. To help students conduct meaningful scientific inquiry and develop a deeper understanding of chemical phenomena, schools should make investments in necessary laboratory supplies and equipment.

- To provide students practical experiences and an understanding of how chemistry is used in their communities, form alliances with nearby farmers, environmental groups, and civic leaders. This partnership has the potential to improve student learning and give their studies a feeling of purpose.

- Encourage a more adaptable curriculum that would free educators from the restrictions of a strict syllabus to include real-world applications and themes related to local traditions. Curriculum guidelines that emphasise contextualised learning experiences may need to be modified in order to achieve this.

- According to the study, chemistry classes should often incorporate group projects and discussions in order to promote a culture of collaborative learning. Students will improve their communication skills and get a deeper comprehension of difficult ideas through peer interaction if they are encouraged to collaborate.

- More student-centered teaching strategies that put the interests and experiences of the students first are required. Teachers should establish a welcoming classroom where students are encouraged to voice their opinions and participate fully in the educational process.

- Regular evaluation measures that emphasise students' participation and understanding of chemical subjects in addition to their academic performance are desperately needed. Formative evaluations will be used to pinpoint areas that want development and offer prompt feedback to assist student learning.

5.4 AREAS OF FURTHER RESEARCH

Investigating the effectiveness of teaching chemistry concepts at primary school using indigenous knowledge and practices.

REFERENCES

Adeo, E. and Agarwal, R. (2020). Collaborative learning in STEM: A practical guide. Education and Educational Technologies, 8(1), 22-35.

Ahmed, M. and Hassan, H. (2020). Exploring traditional agricultural practices to understand chemical reactions. Journal of Agricultural Education, 12(3), 45-58.

Ali, H. (2021). Contextual learning in STEM education: Bridging the gap between theory and practice. International Journal of STEM Education, 7(2), 15-28.

Amir, S. (2020). The impact of limited resources on students' learning outcomes in chemistry. Journal of Educational Research, 35(4), 167-179.

Ba, S. (2019). Incorporating local knowledge in chemistry teaching: A case study. African Journal of Science, Technology, Innovation and Development, 11(2), 205-214.

Balt, R. (2021). Hands-on learning in chemistry education: A necessity for understanding. Journal of Chemical Education, 98(6), 1842-1850.

Beta, K. (2018). Teacher preparedness and resource availability in primary schooling. Zimbabwe Journal of Educational Research, 30(1), 31-46.

Botha, R. (2019). Discursive skills in science education. South African Journal of Education, 39(3), 1-10.

Bowen, G. A. (2009). Document analysis as a qualitative research method. Qualitative Research Journal

Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101.

Braun, V. and Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology,

Carper, J. and Edgars, D. (2020). Challenges in teaching chemistry concepts: Teachers' experiences. Journal of Science Education, 44(3), 223-236.

Cecil, T. (2019). Integrating chemistry and agricultural science: Best practices and challenges. Journal of Integrated Science Education, 10(1), 78-92.

Chetty, M. and Hassan, M. (2021). Local context and real-world applications of chemistry education. International Journal of Education and Development, 13(4), 45-62.

Chitamba, H., Mudzingwa, G. and Chimweta, F. (2020). Resource constraints in teaching chemistry in rural schools. Journal of Educational Development, 6(1), 112-130.

Chitamba, P. (2020). Challenges faced by primary school teachers in teaching chemistry. Journal of Educational Research.

Chitamba, P. and Mapolisa, T. (2020). An investigation into the implementation of STEM education in Zimbabwean primary schools. Journal of STEM Education.

Chitamba, P., et al. (2020). Integrated STEM approaches in primary schools. Journal of STEM Education.

Chitamba, P., Ndhlovu, T. and Machingambi, S. (2020). A qualitative assessment of teachers' experiences in teaching STEM subjects in Zimbabwean primary schools. International Journal of STEM Education.

Cooper, J. (2020). Incorporating practical experiments in primary chemistry education. Primary Science Journal, 15(1), 88-95.

Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. Sage Publications**.**

Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. Sage Publications

Creswell, J. W. (2014). Research design: Qualitative, quantitative, and mixed methods approaches. Sage Publications.

Denzin, N. K. & Lincoln, Y. S. (2011). The SAGE Handbook of Qualitative Research. Sage Publications.

Diallo, A. (2020). The importance of hands-on learning in science education. African Science Education Review, 11(4), 202-215.

Dlamini, M. (2018). Challenges of chemistry education in sub-Saharan Africa. African Journal of Research in Education, 4(2), 98-109.

El Sayed, Z. (2020). Investigating misconceptions in chemistry education. African Journal of STEM Education, 5(3), 101-115.

Etikan, I., Musa, S. A. and Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. American Journal of Theoretical and Applied Statistics.

Evans, E. and Hammersfield, J. (2021). Time constraints in teaching science subjects: A dilemma. Educational Studies in Mathematics, 17(2), 120-132.

Fahmy, M. (2020). Teacher collaboration in STEM education: A framework for best practices. Journal of Educational Change, 21(3), 285-304.

Glesne, C. (2011). Becoming qualitative researchers: An introduction. Pearson Education.

Gueye, M. (2021). Contextual factors affecting chemistry education. International Journal of Science Education, 43(6), 432-449.

Hartzel, N. (2019). Limited resources in rural schools: Implications for teaching STEM education. International Journal of Education and Research, 7(5), 122-133.

Hassan, K. (2019). Incorporating local knowledge into chemistry curriculum: A case study approach. Journal of Cultural Studies in Education, 10(3), 67-79.

Hauer, M. and Baun, B. (2020). Addressing the challenges of STEM education. Journal of Science Education and Technology, 29(4), 516-530.

Herron, D. J. (1996). Constructing an understanding of science through inquiry. Science Education.

Herron, J. D. (1996). The chemistry classroom: Contextual learning. Journal of Chemical Education.

Khan, A. (2020). The relevance of contextual learning in STEM education. Journal of Science Teaching Research, 9(2), 44-50.

Kuhn, D. (2020). Teacher training programs in chemistry education: An evaluation. Journal of Teacher Education, 21(1), 15-29.

Larmer, J. and Caldwick, R. (2020). Strategies for effective science teaching in diverse classrooms. Journal of Science Education, 14(3), 310-320.

Machingambi, T. (2018). An investigation into the teaching of science in Zimbabwean primary schools. Journal of Science Teacher Education, Makoni, R. (2019). ICT integration in Zimbabwean primary schools. Journal of Educational Technology,

Mapolisa, T. (2017). Laboratory facilities in Zimbabwean primary schools: A case study. Journal of Educational Research.

Maulcker, J. (2020). The significance of teacher training in science education. Journal of Education and Teaching, 29(1), 85-92.

Mavhunga, E. (2014). An Analysis of the Zimbabwean Primary School Science Curriculum. Journal of Science Education

McCoy, J. (2020). The impact of teacher training on educational outcomes. Educational Psychology International, 35(2), 134-145.

Merriam, S. B. (2009). Qualitative research: A guide to design and implementation. Jossey-Bass.

Miller, R. (2019). Addressing cultural relevance in STEM curricula. Journal of Educational Equity, 24(2), 67-78.

Morrow, R. A. (2005). Documentation and data analysis in qualitative research. International Journal of Social Research Methodology.

Moyo, J. and Zvobgo, R. (2019). Incorporating local cultural practices into science education. Journal of African Education Research, 14(2), 102-115.

Moyo, S., & Zvobgo, R. (2019). The impact of the heritage-based curriculum on teacher performance in Zimbabwe. Education and Development in Zimbabwe.

Mudyahoto, T. (2020). Teacher training: A cornerstone for effective chemistry education. Journal of Educational Development, 30(1), 60-70.

Mudzingwa, G. & Chimweta, F. (2018). Resource limitations and their impact on teaching chemistry. African Journal of Research in Education, 3(2), 124-130.

Ndhlovu, F., et al. (2020). Student engagement and participation in STEM subjects: A Case Study in rural Zimbabwean primary schools. Journal of Education for Teaching.

Ndhlovu, T. and Mavhunga, P. (2019). Teacher preparedness to teach chemistry in primary schools: A case study of Zimbabwe. Journal of Teacher Education.

Ndhlovu, T., et al. (2020). Student misconceptions in chemistry: A study of Zimbabwean primary school students. Journal of Science Education.

Ndhlovu, T., Machingambi, S. and Chitamba, P. (2020). Improving pedagogical practice: The experiences of teachers in STEM education in Zimbabwean primary schools. Journal of Education and Practice.

News Day (2017): Zim schools embrace STEM(March 22, 2017)

Nkosi, D. (2019). Incorporating indigenous knowledge into science education. African Journal of Indigenous Knowledge Systems, 10(1), 45-58.

Ochieng, A. (2018). Addressing educational gaps in resource-dependent schools. Journal of Education in Africa, 12(2), 99-117.

Odhiambo, G., et al. (2019). Science and Mathematics Education Improvement Project (SMEIP): An evaluation of its impact on teacher training and student outcomes. Journal of Educational Research.

Osama, A. (2020). Enhancing teaching practices through collaborative approaches. Journal of Education Practice, 14(1), 90-100.

Patel, V. (2019). Cultural relevance in STEM education: Bridging the divide. Journal of Multicultural Education, 18(3), 204-213.

Patton, M. Q. (2002). Qualitative research & evaluation methods. Sage Publications.

.

Pretorious, T. and Jansen, D. (2020). Enhancing student engagement through local resources. Education for Sustainable Development, 7(1), 60-74.

Ragab, M. (2019). Developing critical thinking through collaborative learning. Journal of Educational Research, 17(3), 110-119.

Raylotn, K. (2019). Contextual learning and student engagement. Journal of Learning Science, 28(4), 289-302.

Robertson, A. (2020). Incorporating contextual learning to enhance student understanding. Journal of School Science Teaching, 29(1), 45-61.

Saed, K. and Hossam, M. (2019). Cultural practices in education: Challenges and opportunities. African Journal of Education Research, 15(2), 102-117.

Sarr, K. and Hunter, J. (2019). The impact of teaching methods on student engagement. Journal of Teaching and Learning in Higher Education, 34(2), 56-70.

Smith, J. and List, P. (2021). Contextual learning theories and applications. Educational Review, 12(1), 45-60.

Stevenson, J. (2020). Teacher attitudes toward chemistry education reform. Journal of Educational Change, 21(3), 215-229.

The Herald (2016): "New curriculum to promote STEM"(February 22, 2016)

Tristan, L. (2020). Adapting to new chemistry curricula: Challenges for teachers. Journal of Science Education, 36(2), 134-146.

Udit, M. (2019). Innovations in chemistry education: A focus on local practices. Journal of Global Education Research, 6(3), 102-110.

UNESCO (2019). Improving science education: A focus on sub-Saharan Africa. UNESCO Institute for Statistics.

UNESCO IIEP. "Strengthening In-Service Teacher Training in STM Education in Zimbabwe." 2019. https://unesdoc.unesco.org/ark:/48223/pf0000220722)

UNESCO. (2019). Addressing gender disparities in STEM education in Zimbabwe: Challenges and solutions. UNESCO Institute for Statistics.

Van Der Merwe, R. (2020). Barriers to effective chemistry education: Teachers' perspectives. Journal of Education Studies in Zimbabwe, 5(3), 29-40.

Vygotsky, L. S. (1978). Interaction between Learning and Development. In: Mind in Society: The Development of Higher Psychological Processes. Harvard University Press.

Williams, J. & Brown, C. (2020). Effective teaching strategies in chemistry education. Journal of Chemical Education Research, 43(3), 255-270.

Yin, R. K. (2014). Case Study Research: Design and Methods. SAGE Publications.

Zimbabwe Ministry of Primary and Secondary Education (2016): "Curriculum Framework for Primary and Secondary Education"

Zimbabwe Ministry of Primary and Secondary Education (2020). Heritage-Based Curriculum Framework.

Zimbabwe Ministry of Primary and Secondary Education. (2015). National Education Policy.

Zimbabwe Ministry of Primary and Secondary Education. (2017). STEM Policy.

Zimbabwe Ministry of Primary and Secondary Education. (2019). Curriculum Framework for Primary and Secondary Education.

Zimbabwe Ministry of Primary and Secondary Education. (2019). STEM Curriculum Policy: Framework for Zimbabwe. Zimbabwe Government Publications.

Zimbabwe Ministry of Primary and Secondary Education. (2020). Annual Report on Education in Zimbabwe. Ministry of Education, Sport, Arts and Culture.

Appendix 1

Section 1: Interview questions for teachers

Name (optional):……….

Years of teaching experience:………..

Subjects taught:……….

Any specialized training in chemistry? (Yes/No)

Familiarity with chemistry concepts:

How familiar are you with the chemistry concepts included in the STEM-based curriculum?

A) Very familiar

B) Somewhat familiar

C) Not familiar

D) I have no understanding at all

Teaching challenges:

What specific challenges do you face when teaching chemistry-related concepts?

A) Lack of learning aids (textbooks, materials)

B) Difficulty understanding the concepts myself

C) Student disengagement

D) Time constraints in the curriculum

Student understanding:

What do you believe is the biggest challenge for students in learning these concepts?

A) Difficulty grasping abstract ideas

B) Limited prior knowledge of science

C) Lack of interest in the subject

D) Insufficient practice and application

Learning materials and support:

What resources do you currently use to help teach chemistry concepts?

A) Textbooks

B) Online resources

C) Hands-on experiments

D) Visual aids (charts, diagrams)

Professional development needs:

What type of support would help you improve your teaching of these concepts?

A) Training workshops on chemistry

B) Access to teaching materials and resources

C) Collaborations with science specialists

D) Peer support and mentoring

Section 2: Interview questions for students

Name (optional):………

Grade Level:………..

Favorite Subject:……….

Understanding of chemistry concepts:

What chemistry-related concepts have you learned in your classes?

A) States of matter

B) Chemical reactions

C) Basic elements and compounds

D) The scientific method

Difficult topics:

Which concepts do you find most challenging to understand? Why?

A) States of matter (confusing examples)

B) Chemical reactions (hard to visualize)

C) Elements and compounds (too many details)

D) The scientific method (steps are unclear)

Teacher support:

How do your teachers help you learn chemistry concepts?

A) Through lectures and explanations

B) Using practical experiments

C) Providing visual aids

D) Assigning group projects

Interest and engagement:

What makes you interested or disinterested in learning these concepts?

A) Fun experiments increase my interest

B) Long lectures make me lose interest

C) Relating topics to real-life applications

D) The pace of the lessons

Suggestions for improvement:

What suggestions do you have for your teachers to make learning chemistry easier?

A) More hands-on experiments

B) Use of videos and interactive resources

C) More time spent on difficult topics

D) More group work and discussions

The interviewer will allow participants to select their answers from the options provided and encourage elaboration on choices where appropriate.Create a comfortable atmosphere for open dialogue. Record responses (with permission) for accurate analysis.The researcher will ensure confidentiality and anonymity of participants.

How do teachers' lack of training and expertise in chemistry-related concepts impact students' understanding and performance in the subject?

Section 1: Interview questions for teachers

Name (optional):………..

Years of teaching experience:…………

Subjects taught:…………..

Any specialized training in chemistry? (Yes/No)

Curriculum familiarity:

How familiar are you with the chemistry concepts included in your curriculum?

A) Very familiar

B) Somewhat familiar

C) Not familiar

D) I have no understanding at all

Teaching challenges:

How does your lack of training in chemistry affect your teaching?

A) Makes it hard to explain concepts clearly

B) Limits my confidence in teaching

C) Causes me to skip difficult topics

D) I feel it has no effect

Impact on student understanding:

How do you think your training affects students' understanding of chemistry?

A) Students struggle to grasp concepts

B) They seem disinterested and disengaged

C) Their performance on tests is lower

D) I don't think it impacts them much

Resource utilization:

What learning materials do you use to help teach chemistry concepts?

A) Textbooks

B) Online resources and videos

C) Hands-on experiments

D) I rely on whatever I can find

Support needed:

What support would help improve your teaching of chemistry?

A) Professional development in chemistry

B) Access to better teaching materials

C) Mentoring from experienced science teachers

D) More time to prepare lessons

Section 2: Interview questions for students

. Name (optional):…………

. Grade level:…………….

. Favorite subject:…………

Understanding of chemistry concepts:

What chemistry concepts have you learned in school?

A) States of matter

B) Chemical reactions

C) Basic elements and compounds

D) I haven't learned much chemistry

Difficult topics:

Which concepts do you find most challenging? Why?

A) States of matter (too many examples)

B) Chemical reactions (hard to visualize)

C) Elements and compounds (too complicated)

D) I find all concepts easy

Perception of teacher's expertise:

How do you think your teacher's knowledge affects your learning?

A) It helps me understand better

B) I feel confused when they don't know the answers

C) It makes me less interested in the subject

D) I don't notice any difference

Learning support:

How does your teacher support your learning in chemistry?

A) Through clear explanations

B) Using experiments and practical examples

C) Providing visual aids

D) I don't feel supported

Suggestions for improvement:

What could your teachers do to help you learn chemistry better?

A) More hands-on experiments

B) Use videos and interactive resources

C) Spend more time on difficult topics

D) Provide more practice and exercises

The interviewer will allow participants to select their answers from the options provided and encourage elaboration on choices where appropriate. Create a comfortable atmosphere for open dialogue. Record responses (with permission) for accurate analysis and ensure confidentiality and anonymity of participants.

What are the specific chemistry concepts that teachers struggle to teach and students struggle to learn?

<u>Section 1: Interview questions for teachers</u>

. Name (optional):…………..

. Years of teaching experience:………

. Subjects taught:………..

. Any specialized training in chemistry? (Yes/No)

Curriculum focus:

What specific chemistry concepts are included in your curriculum?

A) States of matter

B) Chemical reactions

C) Atoms and molecules

D) The periodic table

Teaching challenges:

Which of these concepts do you find most challenging to teach? Why?

A) States of matter (too abstract)

B) Chemical reactions (students struggle to visualize)

C) Atoms and molecules (difficult for students to grasp)

D) The periodic table (overwhelming information)

Student understanding:

What concepts do you think students find hardest to understand?

A) States of matter (confusion about examples)

B) Chemical reactions (difficulty in predicting outcomes)

C) Atoms and molecules (abstract nature)

D) The periodic table (memorization issues)

Learning materials used:

What resources do you rely on to teach these concepts?

A) Textbooks

B) Online videos

C) Hands-on experiments

D) Interactive software

Support Needed:

What support would help you teach these concepts more effectively?

A) Professional development workshops

B) Access to better teaching materials

C) Collaboration with science specialists

D) More hands-on resources

Section 2: Interview questions for students

. Name (optional):………..

. Grade Level:……….

. Favorite subject:…….

Understanding of concepts:

What chemistry concepts have you learned in school?

A) States of matter

B) Chemical reactions

C) Atoms and molecules

D) The periodic table

Difficult topics:

Which of these concepts do you find difficult to understand? Why?

A) States of matter (too many examples)

B) Chemical reactions (hard to predict what happens)

C) Atomic structure (too abstract)

D) The periodic table (lots of information to remember)

Teacher support:

How do your teachers help you learn these concepts?

A) Through explanations

B) Using experiments

C) Providing visual aids

D) Group discussions

Learning preferences:

What helps you learn better in chemistry concepts?

A) Hands-on experiments

B) Watching videos

C) Reading textbooks

D) Working in groups

Suggestions for improvement:

What could your teachers do to make chemistry concepts easier to learn?

A) Have more experiments

B) Use more visuals and videos

C) Spend more time on challenging topics

D) Provide more practice exercises

Appendix 2

SAMED

P Bag 1020
BINDURA
ZIMBABWE

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

BINDURA UNIVERSITY OF SCIENCE EDUCATION

Date: -----------------------------------

TO WHOM IT MAY CONCERN

NAME: ----------------------- REGISTRATION NUMBER: ---------------------------

PROGRAMME: ------------------------------- PART: ---------------------------

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

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

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

Ndemo

Z. Ndemo (Dr.)
CHAIRPERSON - SAMED

BINDURA UNIVERSITY OF SCIENCE EDUCATION
DEPARTMENT OF EDUCATIONAL FOUNDATIONS
OCT 2024
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