CHALLENGES CHEMISTRY TEACHERS FACE IN IMPLEMENTING THE NEW NSSCO CHEMISTRY CURRICULUM IN OTJOZONDJUPA REGION DURING THE COVID-19 NATIONAL LOCKDOWN

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ABSTRACT

The outbreak of the COVID-19 pandemic forced schools around the world to make an abrupt shift from face-to-face to remote teaching and learning. This study investigated challenges Chemistry teachers face in implementing the new NSSCO Chemistry curriculum in Otjozondjupa Region of Namibia, during the COVID-19 national lockdown. The study is underpinned by the Theory of Curriculum Implementation of Rogan and Grayson, as a theoretical framework. The study adopted an explanatory sequential mixed methods approach, comprising of two phases. In the first phase, a questionnaire was used to gather quantitative data from all (32) Grade 10 and 11 Chemistry teachers from Otjozondjupa Region. In the second phase, semi-structured interviews were used to collect qualitative data from 12 teachers purposively selected from the original sample. Descriptive statistics and thematic analysis were used to analyse the quantitative and qualitative data respectively. The study determined that Chemistry teachers utilised multiple strategies to provide learners with inclusive education through remote teaching and learning. However, teachers experienced difficulties such as inadequate resources and a lack of technological competency to effectively teach Chemistry remotely. Other challenges included: difficulties accessing and staying in contact with learners; inability to engage learners in virtual lessons due to a lack of electronic devices and internet connectivity particularly on the learners' side; nonfulfillment of practical work and difficulty in assessing learners during remote teaching. In consideration of the findings, several recommendations were made, including the recommendation that national government should provide schools with adequate technological facilities and furnish unequipped science laboratories, and

Chemistry teachers should be offered pedagogical training programmes to equip them with e-learning teaching competencies.

Key words: Challenges, Chemistry, Curriculum implementation, COVID-19 pandemic, Remote teaching

LIST OF ABBREVIATIONS AND ACRONYMS

AU	African Union
COVID-19	Corona Virus Disease 2019
DOTSS	Digital connectivity, On-line learning, Teachers as facilitators and motivators, Safety online and offline, Skills focused learning
EFA	Education for All
FRN	Federal Republic of Nigeria
HIGCSE	Higher International General Certificate of Secondary Education
IGCSE	International General Certificate of Secondary Education
JSC	Junior Secondary Certificate
MoE	Ministry of Education
MoEAC	Ministry of Education, Arts and Culture
MoHSS	Ministry of Health and Social Services
NDP	National Development Plan
NPC	National Planning Commission
NSSCAS	Namibia Senior Secondary Certificate Advanced Subsidiary
NSSCH	Namibia Senior Secondary Certificate Higher level
NSSCO	Namibia Senior Secondary Certificate Ordinary level
TUN	Teachers' Union of Namibia
UNESCO	United Nations Educational, Scientific and Cultural Organization
WHO	World Health Organization

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DEDICATION

This study is dedicated to my entire family for their continuous support and encouragement they rendered me during my study.

DECLARATION

I, Josephine Hafeni, hereby declare that this study is my own work and is a true reflection of my research, and that this work, or any part thereof has not been submitted for degree at any other institution.

October 2023

Josephine Hafeni **Signature** **Date**

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CHAPTER 1: ORIENTATION OF THE STUDY

1.1 Introduction

This chapter introduces the study on the challenges Chemistry teachers face in implementing the new Chemistry curriculum for Namibian Senior Secondary Certificate Ordinary (NSSCO) level in the Otjozondjupa Region during the COVID-19 national lockdown. It presents the background of the study, the problem statement and the research questions. The chapter further presents the significance of the study, limitations and the delimitations of the study and the definitions of the operational terms.

1.2 Background of the Study

Rapid changes such as globalization, technology advancement, social reforms and environmental degradation play a pivotal role in curriculum reformation (Ministry of Education [MoE], 2010). Moreover, fast-developing global conditions makes it essential that curriculum frameworks be adapted to change. According to Gilbert (2010) curriculum reform is a review of the "content" of knowledge, including its selection and organisation, and associated issues concerning learners' learning. Curriculum in most education systems is reviewed and revised on a 5-7 years cycle (Ministry of Education, Arts and Culture, 2020a). It is necessary to revise a former curriculum by introducing innovations and changes into the content and implementation that are centered on societal demands (Udu, 2018).

According to the Ministry of Education, Arts and Culture (MoEAC) (n.d.-a), since Namibia gained independence in 1990, the educational system has gone through three major curriculum reforms. The *first* basic education reform took place in 1990, with the introduction of Grade 10 Junior Secondary Certificate (JSC); the International General Certificate of Secondary Education (IGCSE); and the Higher International General Certificate of Secondary Education (HIGCSE) which were approved in collaboration with the University of Cambridge. The *second* changes made to the basic education occurred between 2004 and 2006. These changes included localizing IGCSE and HIGCSE to the NSSCO level and Namibia Senior Secondary Higher (NSSCH) level. The *third* basic education reform began in 2012, which led to changes to basic education structures; review of basic education curricula; phasing out of JSC national examinations; introduction of semi-external examinations at the end of Grade 9; phasing out of the NSSCH level; and the introduction of the Namibian Senior Secondary Certificate Advanced Subsidiary (NSSCAS) level course. Iipinge and Kasanda (2013) state that the first education reform post- independence was considered significant because the apartheid system and assessment practices were no longer suitable to the present situation of providing basic education to the Namibian nation. The government also wanted to "align the goals of the reformed curriculum to that of the new government and international standards" (Ministry of Education and Culture [MEC], 1993, p. 129). The education reforms were recognized as priorities to promote equality, social changes and immediately address the discriminatory policies and curriculum practices of the colonial and apartheid system. The Namibian government restructured the education system to make it relevant to the needs, goals, transformation, and reconstruction of the country. Moreover, the MEC (1993) acknowledged that the

government of Namibia placed a significant importance on education system reform after independence as a means to amend the apartheid legacy.

The education reforms in Namibia were always focused on achieving the four major goals of education which are: equity, access to education, quality, and democracy participation in education (Angula, 2010). Thereafter, a fifth goal was added, which is life-long learning. The purpose of the Namibian educational reform is to have as many learners as possible pass through the education system successfully, to produce a critical mass of an educated and skilled population to create a knowledge-based society (National Planning Commission, 2004). The educational development has been based on the philosophy of education "Toward Education for All" which is built on learner-centered education (MEC, 1993). According to this document, learner-centered education aims to foster young people's curiosity and excitement, as well as to promote democracy and responsibility in lifelong learning. The learner's existing knowledge, skills, interests, and understanding from previous experiences in and out of school serves as the starting point in learner-centered education. Furthermore, it encourages learners to be educational partners rather than simply recipients of education. Lastly, it recognizes learning as an active process with participation from learners in developing, organising, implementing and managing learning (MEC, 1993). To achieve a learner-centered education, a learner-centered curriculum and its implementation are aligned to implement and assess a wide variety of specified core competences and skills that are appropriate for a knowledge-based society which Namibia aims to achieve by the year 2030 (MoE, 2010).

According to Angula (2010), Namibia's post-independence curriculum reform resulted from education policy documents that were approved by the majority of educators, researchers, politicians, parents, and other stakeholders. Stakeholder consensus was recorded by the Ministry of Education in a policy document titled, *Education for All* (*EFA): A Development Brief for Education, Culture and Training* (MEC, 1993). Another policy that gave direction to the education reform, entitled, *Change with Continuity* (Ministry of Education, 1990), was created to establish a framework of operations and parameters for education reform implementation. According to MoE (1990) the same directive identified areas that needed to be reformed as a priority, such as (1) the unification of the national education system; (2) language policy; (3) curriculum reform; (4) the establishment of the National Examination Institute for Educational Development to spearhead education reforms, research and curriculum development; (5) the reform of the national examination system; and (8) the democratization of Education.

As stated earlier, the third reform for basic education in Namibia began in 2012, as per the recommendation of the 2011 National Education Conference (Ministry of Education, Arts and Culture [MoEAC], n.d.-b). The MoEAC (n.d.-b) further states that the review began with the re-organisation of school phases and revision of curriculum content. The overarching goal of curriculum reform was to meet the needs of Namibian society while remaining up-to-date with international trends. Furthermore, the curriculum was revised to give basic education direction, as a critical step toward achieving *Vision 2030* and to align it with the aspirations of the National Development Plans (NDPs). *Vision 2030* envisions Namibia evolving from a literate society to a knowledge-based society, where

knowledge is continuously gained, transformed, and applied to innovation to raise the standard of life (Government of the Republic of Namibia, 2004). The revised curriculum guarantees that the fundamental principles of Namibian's educational system continue to be upheld, as outlined in *Toward Education for All: A Development Brief,* in 1993. The goals, aims, competencies, core skills and key learning areas have been identified in relation to *Namibia Vision 2030* as a curriculum for the future (Ministry of Education, Arts and Culture, 2016).

After the finalisation of the third basic education reform, its implementation then commenced in 2015 with the junior primary phase, targeted for a full implementation to take place by the year 2021 in Grade 12 (Ministry of Education, Arts and Culture, 2015). Significant change noted in the science curriculum is the replacement of Physical Science by Chemistry and Physics as two distinct subjects in Grades 10 and 11. This change was meant to enhance the curriculum by restructuring and adding new complex topics to equip learners with extensive knowledge. Thus, as of 2019 the subject of Chemistry for NSSCO has been implemented for the first time in Namibian secondary schools offered as a two-year course, with its first implementation in Grade 10 having taken place in 2019 and in Grade 11 in 2020 (MoEAC, n.d.-a).

The National Curriculum for Basic Education (NCBE) in Namibia, which is the broad curriculum, states that Science is one of the driving forces behind the societies and the world's transformation. It further suggests that science is one of the key learning areas in the NCBE as it "contributes to the foundation of a knowledge-based society by empowering learners with scientific knowledge, skills and attitudes to formulate hypotheses and investigations, observe, make deductions and understand the physical

world in a rational, scientific way" (Ministry of Education, Arts and Culture, 2018b, p. 13). Hence, there is a need for learners to advance into scientific literate citizens (MoE, 2010). Moreover, it states that the Namibian society has a need to be scientifically literate to be able to navigate the challenges of appropriate global technology requirements. Khishfe and Lederman (2007), Nowak et al. (2013) and Peters-burton (2016) noted that the central goal of all global reform efforts in science education is to achieve a scientifically literate citizenry.

The relevance of Chemistry education in general education has been recognized on a global scale, making it one of the most important disciplines in the school curriculum (Achimugu, 2016). According to Muse et al. (2018, p. 100) "the ultimate goal of studying Chemistry is to enhance people's understanding of the composition, structure, properties and changes of matter while under varied conditions". Similarly, Chemistry is a requirement for admission to scientific careers and helps to ensure continuous availability of students who take important occupations such as engineering, pharmacy, medicine, dentistry, food science, environmental education, etc. (Ikechuchu, 2011; Njagi & Silas, 2015). Ogbu (2012) also note that Chemistry provides a theoretical basis for the synthesis of drugs used for medicines, soaps, detergents, textiles, shoes, and plastics. Chemistry is mostly regarded as the "Central Science" or the "Mother of all Sciences" owing to its confluence and impact (Ahiakwo, 2002). Furthermore, Chemistry is important for national technological advancement (Udu, 2018). It is therefore crucial for any country that wants to be among the developed nations to take the teaching and learning of Chemistry seriously (Federal Republic Of Nigeria, 2004). Considering the

above, it can be asserted that it is critical that the subject of Chemistry be properly implemented to all enrolled learners (Edomwonyi-Oto & Avaa, 2011).

On January 30, 2020, the World Health Organization (WHO) declared a global emergency of a disease referred to as Corona Virus Disease 2019 (COVID-19) and subsequently on March 11, 2020 it was declared a global pandemic which rapidly became a massive international concern (Wang et al., 2020; World Health Organization [WHO], 2020b). According to WHO (2020b) COVID-19 is caused by a virus initially identified in December 2019 in Wuhan, China and has since spread into a world pandemic. In Namibia, the first COVID-19 confirmed cases were reported on March 13, 2020. On March 17, 2020 the Head of State, His Excellency, the President of the Republic of Namibia, Dr. Hage Geingob declared a State of Emergency in the country, under Article 26(1) of the Namibian Constitution read together with section 30(3) of the Disaster Risk Management act, 2012 (Act No. 10 of 2012) on account of the occurrence of Coronavirus disease (Republic of Namibia, 2020). COVID-19 is extremely contagious and spreads mostly through direct contact with infected person or products they use, surfaces in their immediate vicinity, and through droplet transmission (Shereen et al., 2020; World Health Organization [WHO], 2020a), and it affects all areas of life, including health, education, tourism, and economics (Sintema, 2020).

Sadly, as of 19 June 14, 2022, globally there were over 533 million confirmed cases of COVID-19 with more than 6.3 million confirmed deaths as a result of COVID-19 (World Health Organization, 2022). Within the same period, over 168 448 COVID-19 confirmed cases and more than 4049 confirmed deaths have been reported in Namibia (Ministry of Health and Social Services, 2022).

As a response to this global pandemic, Namibia, like other countries around the world dealing with the COVID-19 crisis, introduced intensive measures to limit the spreading of the disease and its effects. One of the restrictive measures introduced in the country was a total national lockdown, which caused unexpected disruptions to different sectors. In education, the major impact of COVID-19 was the temporally closure of schools across the country as of 17th March 2020 (MoEAC, 2020b). The modes of transmission of coronavirus discussed earlier justify the suspension of face-to-face classes. According to Esposito and Pricipi (2020) and Sahu (2020), the closure of schools in many countries was regarded as one of the intensive measures to decrease the spread of coronavirus in a society by breaking key chains of the virus transmission. Furthermore, the government's decision to ultimately close schools was a positive move to protect learners from possible risks of contracting COVID-19 because a school environment is where large numbers of learners meet, and this makes it a risky place where the diseases can spread quickly (Sintema, 2020). According to data from UNESCO (2020b), by mid-May 2020, it was estimated that over 87% of learners worldwide, which comprise of more than 1.5 billion learners in 165 countries had temporarily stopped having face-to-face classes. This was all done to mitigate the spread of the virus.

However, the move to close schools resulted in unprecedented changes to education as face-to-face teaching and learning immediately came to a halt. It is important to note that Namibia being an African Union (AU) member state, was obliged to provide an Education Sector Response plan to the COVID-19 pandemic underpinned by the following amongst other actions:

> *Ensure continuity of learning on-line based on the DOTSS (Digital connectivity, on-line-learning, Teachers as facilitators and motivators, Safety on Line and Off-line, Skills focused learning) approach and also to ensure that teachers are skilled, capacitated, and motivated to support learners off-line and on-line* (African Union, 2020, p. 4).

Likewise, the constitution of the Republic of Namibia makes provision for education for all person as a right and it places the responsibility on the government to deliver education to its people. The outbreak of COVID-19 pandemic made the fulfillment of this moral obligation daunting but, it did not absolve the government of its responsibility to ensure continuance of inclusive and quality education for all learners.

In the light of the aforementioned circumstances, the Ministry of Education, Arts and Culture called for an implementation of remote teaching and learning so that learners continued to receive education from home until a point where schools could resume (MoEAC, 2020b). Circular 3/2020 of the MoEAC (2020b), emphasized that learners were to be provided with "continued learning" using other modes other than the teacher being physically present in the classroom for formal face-to-face teaching approach. Furthermore, the understanding here is that learners were to be kept meaningfully and purposefully engaged and always learning to enable them to re-integrate into formal learning once schools re-open. As a result, all teachers throughout the country, including the Chemistry teachers had to instantly adjust to a new mode of teaching during the COVID-19 national lockdown.

Studies conducted in other countries regarding teaching and learning during the COVID-19 lockdown reported a wide array of challenges. For instance, a study conducted in Indonesia revealed that teachers could not virtually reach all the learners due a lack of technological devices and limitation of internet network (Zahara et al., 2020). Similarly, in a study conducted in the United States, teachers reported offering distance learning to learners in the midst of COVID-19, but only 12% of teachers reported covering all or nearly all of the curriculum they would have covered had the schools remained open (Diliberti et al., 2020). The authors further indicated that a lack of learner technology facilities was a major challenge. In Slovakia, it has been reported that Chemistry and other science teachers were particularly in a tough situation in comparison to the other teachers (Babinčáková & Bernard, 2020). This is because they not only had to organize teaching of theoretical knowledge but also practical aspects, involving transferring experiments and laboratory activities to an online setting (Babinčáková & Bernard, 2020). In a similar study, Shidiq et al. (2021) found out the following: Chemistry teachers were unable to conduct lab work-related activities in the laboratories which reduced learners' understanding of the subject matter; the teacher's ability to impart character education in learners was hampered by the lack of physical teacher-learner interaction; there was a greater chance of misconceptions in learners as there was little control of teachers on learners' understanding; and lastly, the assessment of the learning outcomes proved challenging. In Zambia, COVID-19 also had an immense impact on the quality of education. This impact was due in large part because of inadequate communication between teachers and learners, loss of learner contact hours as a result of not being able to consult teachers on their individual learning needs, and limited technology facilities for online learning (Sintema, 2020).

Studies on distance learning have revealed that when teaching and learning online, science teachers lamented due to a lack of contact hours which they perceived to have an adverse impact on students' performance. Implementing science subjects through online learning was also found to be slower compared to other subjects because the teaching of science subjects requires practical work (Hallyburton & Lunsford, 2010). According to Islam et al. (2015) further challenges associated to distance learning, similar to traditional learning, include challenges in learning styles, pedagogy, technology, culture and time management.

Understanding the challenges encountered by Chemistry teachers in curriculum implementation during the COVID-19 national lockdown, is of significant importance because teachers are the primary mediators in any curriculum implementation in schools and the success of any programme depends on its implementation process (Fullan, 2007). Supporting this is Okecha (2008) in Ejidike and Oyelana (2015) who asserts that teachers are the catalysts for enhancing behavior transformation and learning processes amongst learners. As such, teachers occupy an essential position in curriculum practice as they steer the actual curriculum implementation in the classroom. Achimugu (2016) added that to accomplish the purposes of any subject in schools, teachers have an integral role to play because they are the bridge between the curriculum and the learners. Hence, a teacher is responsible for the effective implementation and meaning of a curriculum and is therefore the facilitator for curriculum innovation and education reform. In this context, teachers' experiences and challenges, ultimately determine national curriculum implementation interventions (Bantwini, 2010).

Gudyanga (2017) argues that despite substantial contributions to the curriculum implementation literature, gaps remain in knowledge concerning teachers' challenges, and their significance in curriculum implementation outcomes. Equally, Rogan and Grayson (2003) assert that although policy documents contain visionary and academically sound ideas, implementation of these concepts often proves to be slower and more challenging than expected, and especially during periods of national crises, such as COVID-19 pandemic. Adal (2011) also highlights that the teacher is the most significant professional interacting with learners and is directly responsible for achieving curriculum objectives. Therefore, their professional challenges, views, and perceptions regarding their teaching role and learning process is of the greatest importance. This issue should always be put into greater consideration, especially during periods of educational reform and national emergencies, where teachers are obligated to change their mode of delivering lessons.

Considering that Chemistry has just been implemented recently for the first time at the senior secondary phase in the Namibian educational context, there is a necessity to investigate challenges Chemistry teachers experienced during the new curriculum implementation particularly during COVID-19 national lockdown. This is substantiated by Tubaundule (2014) who states that there is a need for continuous study of curriculum implementation locally. Through such studies, which involve exploring challenges and views related to applying the policies into practice, it will generate knowledge to guide Namibian educators and policy makers better understand factors influencing the implementation of the curriculum. Gudyanga (2017) also points out that teachers' views,

perspectives, and the challenges experienced during curriculum implementation should be explored to increase the chance of its successful implementation.

Supporting teachers to determine and cope with their challenges and aligning reform concepts with what they already know from their experiences is critical for successful curriculum implementation and associated outcomes. To best support Chemistry teachers during COVID-19 or similar pandemics, it is important to investigate and understand what challenges they experience during curriculum implementation, to generate knowledge about lessons learned and best practices about how teachers respond in such situations. This knowledge can impact how government and other stakeholders responds, based on scientific evidence.

There are no documented studies conducted in Namibia to determine the challenges Chemistry teachers faced as they implement the new NSSCO Chemistry curriculum during the COVID-19 national lockdown. Hence, this research serves as a comprehensive investigation into the challenges Chemistry teachers faced in implementing the new NSSCO Chemistry curriculum. Understanding these challenges will undoubtedly increase knowledge and assist in informing present and future implementation of the Chemistry curriculum during times of national crises, such as COVID-19 pandemic.

1.3 Statement of the Problem

In an effort to salvage the educational academic year for 2020 amid COVID-19 pandemic, two weeks into the national lockdown, the government through the MoEAC (2020b) called for all teachers in Namibian schools to implement and facilitate online

learning through technological devices such as laptops, tablets and smart phones. This was necessitated to enable teaching and learning to continue until a point where teachers and learners could resume physical contact. Hence, teachers had to unexpectedly embrace a new mode of teaching to provide education to the learners during the lockdown. However, according to the Teachers Union of Namibia (2020) most teachers did not have prior experience or training in online teaching and learning. This implies that most Chemistry teachers did not have the capacity and necessary skills to implement online learning effectively during the lockdown. Gokmenoglu and Clark (2015) stress that teachers are tasked and entrusted to implement a curriculum successfully, but their voices, challenges and personal experiences in curriculum implementation are often not adequately studied. In this case, there seems to be no research study conducted in Namibia in which teachers as curriculum implementers had an opportunity to voice their experiences as they implement the NSSCO Chemistry curriculum during the COVID-19 pandemic national lockdown. Hence the need to carry out this research.

1.4 Research Questions

The study sought to answer the following research questions:

1. What are the challenges experienced by Chemistry teachers in the implementation of the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown?
2. What are the views of Chemistry teachers on the implementation of the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown?

3. How can the Chemistry teachers effectively implement the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown?

1.5 Significance of the Study

The findings of the study will provide policy makers and those responsible for monitoring the implementation of the new NSSCO Chemistry curriculum with insight into the implementation of the curriculum during the COVID-19 national crisis and how the Chemistry teachers in Otjozondjupa Region coped with facilitating remote teaching. The study will also provide information on how Chemistry teachers can be supported in implementing the Chemistry curriculum particularly, during a crisis such as the COVID-19 pandemic. The study will assist teacher training institutions on best practices for future Chemistry teachers by aligning programmes with the ever-changing trends in teaching practices, with a focus on online learning. The study will also enable Chemistry teachers in Otjozondjupa Region to reflect on their own experiences of implementing the Chemistry curriculum remotely which will allow them to re-evaluate their practices. In turn this will empower them to build their capacity in remote and online learning and teaching. Finally, the research will serve as a resource document for other educational researchers, particularly on Chemistry curriculum implementation in a local context during times of national crises.

1.6 Limitations of the Study

The researcher found it difficult to get sufficient time to carry out the interviews as the interviewees are full time employees. To overcome this limitation, the researcher was flexible to alter her schedule and was available at the interviewees' convenience.

1.7 Delimitations of the Study

The study was limited to secondary schools in the Otjozondjupa Region because of ease of access to the researcher. Therefore, the findings obtained from research cannot be generalized to secondary schools in other regions.

1.8 Operational definition of terms

A **challenge** is something that is difficult and requires great mental or physical effort in order to be done successfully (Cambridge University Press, 2013).

Chemistry is a branch of science that studies the structure, composition, and properties of substances, as well as the transformations that they go through (Chiechi, 2012).

Curriculum is a document that guides schools on how to organize the teaching and learning process and provides a clear outline to ensure consistency in curriculum delivery (Johnson, 2012).

Curriculum implementation entails putting official prescribed courses of study, syllabi, and subjects into practice in schools (Johnson, 2012).

COVID-19 pandemic is a worldwide outbreak of infectious coronavirus 2019 caused by Severe Acute Respiratory Syndrome Corona Virus 2 (SARS CoV-2) (WHO, 2020a).

Remote teaching is when instructional delivery (teaching) occurs outside of a physical classroom, educational instructions and activities are delivered online and sometimes through physical resource distribution (Hodges et al., 2020).

1.9 Summary of the chapter

The study was introduced by covering the background of the study, statement of the problem, research questions, the significance of the study, and the definition of key terms used in the study. The next chapter presents the theoretical framework and the review of relevant literature.

CHAPTER 2: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

2.1 Introduction

This chapter presents the study's theoretical framework and explores and presents literature concerning the subject matter. The literature review has a dual purpose of satisfying the research objectives and contextualizing the subject matter in a manner that provides sufficient basis for the relevance of the study in a local context. The COVID-19 pandemic occurred unexpectedly and with it resulted in multiple challenges, particularly regarding learners' access to education in the absence of face-to-face classes. These challenges were more pronounced in subjects such as Chemistry because of increased practical components of implementation. Studies indicate that science subjects are difficult to teach virtually due to their complexity and need for continuous explanations and illustrations in laboratories. The literature outlines some of these challenges that Chemistry teachers faced along with their perceptions regarding remote teaching during the COVID-19 pandemic. A number of other key focus areas presented in the literature are curriculum change, the concept of Chemistry curriculum implementation, education sector in Namibia during the COVID-19 pandemic, Challenges in teaching Chemistry remotely and factors which lead to successful remote teaching. The literature also discusses opportunities for education in the face of COVID-19 pandemic. Due to the limited literature in Namibia on the problem under investigation, much of the reviews were drawn from studies conducted in other countries.

2.2 Theoretical Framework: The Theory of Curriculum Implementation

The study is informed by the Theory of Curriculum Implementation (Rogan and Grayson, 2003), which is underpinned by three major interrelating constructs: profile of implementation, capacity to support innovation and support from outside agencies. The profile of implementation expresses the types and extent to which the ideals of a curriculum are put into practice (Tawana, 2009). The construct and capacity to support innovation is concerned with factors found within a school itself that can support or hinder the implementation process of an innovation. In this regard, the emphasis is on Chemistry teachers' educational backgrounds, their experiences of teaching a science subject virtually and how they coped during the COVID-19 crisis, the physical resources available such as technology facilities, and the challenges they faced. The third construct, which is support from outside agencies, refers to support given by organisations outside the school. Examples of such organisations are advisory departments, teachers' unions, and non-governmental organisations.

The theory of curriculum implementation directed the identification of the data relevant to the research problem. In addition, it provided a theoretical lens through which the findings of the study were interpret.

Figure 1 lays out the constructs and sub-constructs into the framework.

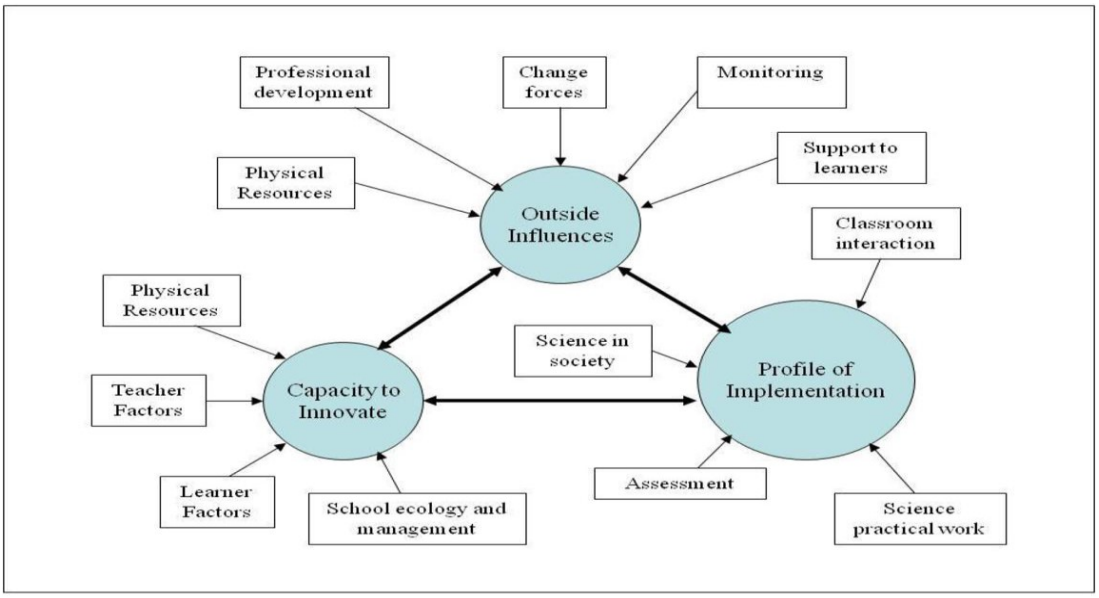

Figure 1: The constructs and sub-constructs of Rogan and Grayson's theory

2.2.1 Profile of Implementation

The profile of implementation is a crucial component in the theory of curriculum implementation. The profile of implementation focuses on the levels to which ideals of a curriculum are laid into practice. It is concerned with classroom activities, learner interactions with one another, teachers, and learning materials, as well as communicative discourses based on learning and teaching models (Tawana, 2009). The profile of subject implementations and their efficacy in implementing curriculums differ due to differences in the pedagogical aspects of subjects. For example, because Chemistry is a science subject that interacts with the physical world, practical work in which learners engage their senses in the course materials is an important component. Hofstein and Kesner (2006) point out that through physical participation, practical work in Chemistry

helps learners develop problem solving skills to explain everyday problems. Therefore, the removal of the practical element in teaching Chemistry through virtual teaching and learning as in the times of COVID-19 removed the physical component which is an essential part of Chemistry curriculum implementation.

2.2.2 Capacity to Innovate

Capacity factors are those indicators emanating from the physical resources, learner, and teacher factors along with the school setup. These factors are critical structures in determining what result in effective learning; however, depending on their sufficiency, these factors can also be a source of hindrance to curriculum implementation (Tawana, 2009). Factors such as the study and work conditions of teachers and learners, school ethos, language of instruction, leadership patterns and functionality of school can influence the extent of learning and teaching (Garegae, 2003). These broad areas indicate the critical nature of a well-developed capacity in providing quality teaching and learning. Capacity for innovation was an important theme in the implementation of the Chemistry curriculum during COVID-19 pandemic as these capacities determined whether the pedagogical aspect of the subject was achieved. In this case, the focus was on the capacity of teachers to effectively teach Chemistry virtually, particularly using online learning tools in a manner that aligns to the profile of implementation, the ability of leaders to mobilize electronic resources and the support necessary, as well as the capacity of learners to learn using different mediums of learning.

2.2.3 Support from Outside Agencies

One of the major challenges encountered in curriculum implementation during the COVID-19 pandemic was a lack of resources, thus the constituent of curriculum implementation theory is important. Schools and the Ministry of Education, Arts and Culture faced a lot financial constraints due to the unforeseen pandemic, making assistance and support from outside organisations even more vital. Provision of resources is an important aspect to learning and to the functionality of schools (Hewson et al., 2001). Leech et al. (2020) explain that the availability of resources such as technology tools and the provision of additional support to teachers is one of the most important indicators of access to and provision of quality science education during remote teaching. As a result, a positive support system fosters a favourable learning climate, whereas an unfavourable climate hinders learners' ability to learn. In this light, negative environments led learners to disengage from learning (Hewson et al., 2001). Support in this context refers to resources needed, such as human resources, textbooks and any other required materials (Hewson et al., 2001; Koosimile, 2005).

2.3 Curriculum change

King et al. (2001) state that curricula cannot be fixed as it evolves to cater to the demands of society. Social-reconstructionist holds the view that learners are an important component in delivering social change and through schools this change can occur. According to Nias (1991), to ensure the reconstruction of a society, it is crucial that the curriculum fosters values and knowledge that will warrant the creation of a new social order. According to the literature, curriculum changes should coincide with social

and economic changes, as learners must adapt and function in changing environments (Yorke & Knight, 2006). Beare (2001) concurs with the aforementioned sentiments and supports curriculum paradigm shifts as necessary because it ensures that schools develop learners who will be able to operate and function in a changed environment. In an example of changed curricula, Cheleen and Shu-Wei (2006) give Singapore as an example of the significant differences between schools of the industrial and pre-industrial eras. It illustrates that schools in a knowledge- based societies of the twenty first century transform their curriculum to prepare learners as per the needs of the nation.

2.4 Curriculum Implementation

According to Nevenglosky et al. (2019, p. 5), "curriculum implementation is concerned with how teachers deliver instruction and assessment through the use of specified resources provided in a curriculum". It is from curriculum designs where instructional recommendations, scripts, lesson plans, and assessment options are linked to learning objectives (Nevenglosky et al., 2019). These designs focus on consistency to help teachers successfully implement and preserve the curricular structure for learning objectives (Wiles & Bondi, 2014).

McNeill et al. (2016) state that comprehending concerns and the beliefs of teachers can provide insights into the success or failure of curriculum implementation. McNeill et al. (2016) revealed that teachers' perceptions have a significant influence on their decisions for instruction. Given that the beliefs of teachers play such an important role, it is necessary to understand teachers' values, perceptions and concerns as a means to improve the implementation process (Al-Shabatat, 2014; Rakes & Dunn, 2015).

According to Ben-Arye et al. (2021) during the COVID-19 pandemic teachers had negative perceptions towards teaching using e-learning because of their inability to teach using this mode and learners' lack of ability and resources to learn using this medium.

Curricular implementation consists of various components, including curriculum delivery via instructional practices and resources. To implement curricula effectively, instructional practices must align with the curriculum and support learners' individual needs (Causarano, 2015). It is essential to identify the individual needs of learners relating to e-learning and if their needs were factored in. However, it is not only the needs of learners that is to be addressed when assessing e-learning, as McNeill et al. (2016) indicate, teacher preparedness for curriculum implementation is of absolute importance also. Bell (2015) asserts that a lack of guidance and training for curriculum implementation is a challenge impeding effective teaching delivery to learners. This barrier can negatively influence learner learning and growth (Causarano, 2015).

2.5 Role of teachers in curriculum implementation

According to Zhang et al. (2016) the roles of teachers remain key in the efficacy of curriculum outcomes. Scholars have agreed on the importance of understanding teachers' concerns and roles during the implementation of a new curriculum (Hall & Hord, 2015). Of the multiple roles presented by literature, teacher fidelity is one of the most important elements, but also the most inconsistent component found among teachers (Zhang et al., 2016). Jess and Keay (2016) further indicate that teachers must be trained effectively to meet the objectives of a curriculum. More specifically, the authors' focus was on the curriculum-development process. Furthermore, they propose that

teachers should build their professional capacity to design developmentally sufficient learning tasks, aligned to curricular expectations.

The objective of training and professional development is to draw attention to teaching in a way that best interprets the curriculum and align learners' needs with appropriate instructional processes (Jess & Keay, 2016). To support such processes, according to Jess and Keay (2016) this includes involving teachers in curriculum development and processes of alignment. Jess and Keay (2016) likewise found that understanding how teachers see their role in curriculum development and implementation provides insight into teachers' concerns and perspectives on implementing a new curriculum.

2.6 The New NSSCO Chemistry Curriculum

According to the Ministry of Education, Arts and Culture (MoEAC) (2018a, p. 1) "the Namibia Senior Secondary Certificate Ordinary (NSSCO) level syllabus was designed as a two-year course leading to examination after completion of the Junior Secondary phase". One of the aims outlined by the MoEAC (2018a, p. 2) concerning the Chemistry curriculum is the provision of "well designed studies of theoretical and practical science". The latter aspect of practical science is particularly important to this study because practical work in science and Chemistry means a hands-on approach to learning in which all senses are engaged. Because of the school closure due to COVID-19 pandemic, the practical aspect was unattainable in remote teaching.

2.7 The concept of Chemistry curriculum implementation

The implementation of the Chemistry curriculum refers to putting the prescribed syllabus into practice. Makato (2016) states that Chemistry provides a diverse set of learning experiences. The scope of learning encompasses content, projects, practical work, excursions, group discussions, and field work (Makato, 2016). When learners are sufficiently exposed to the aforementioned experiences, the implementation of the Chemistry curriculum can be deemed satisfactory. According to Mwangi (2016) Chemistry, like other science subjects, has both theoretical and practical components that complement each other during the teaching and learning processes. The theoretical aspects of the subject can be mastered effectively through traditional methods; however, experiments are required to study the practical content. Okono (2015) mentions that the teaching of Chemistry through using experimentation pedagogical strategies contributes to effective teacher instruction and increases mastery of concepts by the learners. This is why, according to Kapting ' Ei and Kimeli (2014), Chemistry teachers are urged to expose learners to more experiments in the subject to achieve satisfactory performance. Mwangi (2016) indicates that experiments can be done in two ways, through class experiments and via demonstrations. In the case of class experiments, learners engage in practical activities while making and recording observations either individually or in groups. One advantage of experiments is that they have been shown to help learners develop their scientific process capabilities (Kapting ' Ei & Kimeli, 2014).

2.8 Facilities and the implementation of the Chemistry curriculum

Studies indicate that, for the achievement of quality education, the provision of educational facilities and materials is mandatory (Atieno, 2014; Ituma, 2012; Makori & Onderi, 2014; Ongweno, 2015). A study by Achimugu (2016) assessing the factors that influence Chemistry curriculum implementation in Nigeria reported that a lack of equipped science laboratories negatively impact the implementation of the curriculum. In Kenya, it was reported that because many schools have equipped laboratories, there are increased reports of effective teaching of Chemistry (Muse, 2017). Mwangi (2016) asserts that that some Chemistry practical components can be performed within the classrooms or outside, however, the laboratory is the most effective venue for conducting Chemistry experiments. This is because laboratories have been designed with appropriate infrastructure for experimentation. In order for Chemistry laboratory to fulfil its intended purpose, Gatana (2011) suggests that a conducive laboratory design entails a sufficient water supply, appropriate furniture, adequate ventilation, reliable power supply, and appropriate scientific equipment.

2.9 Materials and implementation of Chemistry curriculum

Aside from the necessary fittings, the lab must have safety equipment, stock records, and instructional materials. These instructional materials have an impact on the Chemistry curriculum's implementation. Gatana (2011) states that a lack of adequate chemical apparatus and materials for teaching Chemistry results in learners performing poorly in the subject. Ejidike and Oyelana (2015) assessed the factors affecting the implementation of the Chemistry curriculum in Eastern Cape Province, South Africa and

the results showed that ineffective implementation of the Chemistry curriculum within the region was a result of inadequate textbooks, apparatus, chemicals and lab safety kits. Makori and Onderi (2014) identified the impact that inadequate resources had on curriculum implementation, which often causes teachers to be solely dependent on textbooks, resulting in insufficient syllabus coverage and assessment.

2.10 Teacher qualification and implementation of the Chemistry curriculum

A core component of curriculum implementation is the teachers' capabilities. This includes subject matter knowledge and, in the research context, the ability to conduct classes remotely. Remote teaching necessitates computer knowledge, educational media, and an understanding of how to improve learning effectiveness in non-face-to-face situations. According to Chepkorir et al. (2014) Chemistry teachers must be equipped with the necessary skills, competencies, and attitudes in order for curriculum implementation to be effective. Having the necessary skills and good mastery of subject content are essential because they allow teachers to clearly explain abstract aspects of subjects to learners (Chepkorir et al., 2014). Removing the abstractness of the subjects helps learners understand the subject and recognise its importance.

Buabeng et al. (2014), in their study about the influence of the qualifications of Physics teachers on learners' achievement in high school in Nigeria, reported that teacher qualification has significant impact on the performance of learners. Additionally, Njagi and Silas (2015) purport that the ineffective management of Chemistry practical work by ill-suited teachers reduces learners' performance in the subject. According to Zinganyu (2010) while assessing the factors hindering curriculum implementation in secondary

schools, a lack of in-service training for teachers was observed. Equally, Ejidike and Oyelana (2015) stated that few experienced and qualified teachers in South Africa's Eastern Cape Province attended in-service training courses, seminars, and workshops to assist them with curriculum implementation. On that note Chemistry teachers must be continuously trained to improve their pedagogical capacities in order to keep up with innovative trends in curriculum implementation.

2.11 Effects of COVID-19 on curriculum implementation

As a result of COVID-19, schools across the world were forced to close, causing an increased reliance on alternative modes of lesson delivery as a way to continue with teaching and learning (Goldschmidt, 2020). The effects of COVID-19 included disruption of curriculum scheduling, and in some cases, removal of some subject content for the academic year. Examinations were postponed in some countries, in some, they were cancelled and in others, they were replaced by continuous assessment (United Nations, 2020). Di Pietro et al. (2020) noted that the learning process was negatively impacted by school closure due to less time spent learning, stress symptoms in children as a result of being confined at home, and by a lack of motivation.

The failure by many schools to successfully implement curriculum during the pandemic has been exacerbated by unequal access to internet connections and an uneven distribution of learning resources, particularly for low-income and vulnerable populations (Rieble-Aubourg & Viteri, 2020). UNESCO (2020a) recommends that governments prioritize education continuity and contact for learners who have difficulty connecting to the internet and live in socioeconomic conditions that do not support

distance learning processes. It is equally essential for educational authorities to develop protocols for continuing education when schools reopen following the COVID-19 pandemic, and these protocols must take into account the disparities that widened during the crisis (UNESCO, 2020b). Alvarez et al. (2020) indicate that the pandemic changed the contexts in which curricula are implemented, not only because of the use of platforms, but also because of the need to consider teaching circumstances other than those for which the curriculum was originally designed, particularly for practical subjects like Chemistry.

2.12 Education sector in Namibia during the COVID-19 pandemic

Nashilongo (2020) stated that when assessing the challenges of online learning during COVID-19, it is essential to present the state of technological advancement and the issue of internet connectivity across the country. A circular released by The Ministry of Education, Arts and Culture on how to deal with schooling during COVID-19, indicated that telecommunication infrastructure was the biggest challenge, when considering that 32% of the schools (614) in the Namibia did not have access to telecommunications and the internet (Nashilongo, 2020). In addition, Basilaia and Kvavadze (2020) observed that most schools in Namibia were unprepared for the implementation of nationwide online learning due to poor technology.

In a news article, Boer and Asino (2022) described insights teachers provided concerning online teaching in Namibia during the COVID-19 pandemic. Some teachers stated that online teaching highlighted the inequality to education among learners because not all learners had access to the learning content due to a lack of technology

tools and lack internet connection. They further revealed that the availability of digital resources for teachers and learners defined what teachers were able to do, hence most teachers could not comply with the directive from the education ministry to apply online learning and thus had to find other ways of conducting teaching through the distance approach.

2.13 Types of communication in remote learning

There are two types of communication in remote education. These include asynchronous and synchronous communications. Bates and Poole (2003) define synchronous communication as participants interacting at the same time, such as a live stream class or lecture or a live two-way interaction between several learners and a teacher. Asynchronous communication necessitates the presence of interacting class participants at the same time; in this case, emails and discussion forums can be used. According to some researchers, 'blended' modes of communication produce optimum learning outcomes (Bates & Poole, 2003; Rennie, 2003).

Rennie (2003) indicated that blended learning approaches which include multiple delivery modes, including asynchronous and synchronous, offer greater flexibility and security for students. “A mixed format spreads the risks and benefits of synchronous and asynchronous support between a wide range of 'high' and 'low' technologies and provides a backup” (Rennie, 2003, p. 33). While the variety of modes is ideal, learner access is influenced by geographic and economic factors (Mills et al., 2005).

Communication types may vary depending on intended learning outcomes. Allen et al. (2004) states that the type of communication utilized in a distance course may impact

learner satisfaction, which in turn affects learner retention and dropout rates (Allen et al., 2004). A study by Bullen et al. (2012) showed that students appreciated access to the ideas and opinions of other students in online discussion, thus this had a positive impact on learner interaction and group involvement.

2.14 COVID-19 pandemic and Distance Learning

Interchangeable terms used globally include, 'open learning', 'flexible learning' 'distance learning' and 'remote learning' which are all alternatives to traditional ways of the teaching-learning processes. Once COVID-19 was found in China, a 'School's out, but Class's ON' strategy began in China, and this similar practice moved to the rest of the world (Zhou et al., 2020). Some countries such as Singapore began teacher training early in anticipation of school closures, whereas others, such as Lebanon, chose to send learners home with lessons as homework in order to promote independent distance learning with the assistance of peers and parents (World Bank, 2020).

According to Singh and Thurman (2019) online learning is defined as learning experiences in asynchronous or synchronous environments using various devices with internet access (e.g., laptops, tablets, and mobile phones). Students can be anywhere to learn and interact with teachers and other students (Singh & Thurman, 2019). Online learning allows students to interact directly with learning material that is available in a variety of formats (e.g., video, audio, document, etc.). Important online tools identified during the COVID-19 pandemic are Google and Zoom (Basilaia & Kvavadze, 2020).

2.15 Distance Learning and Rural-Urban Divide

In Namibia like other developing nations, education inequality is still observed between urban and rural areas (Nashilongo, 2020). Income disparities, institutional barriers, and different parenting styles are all thought to be causes of educational inequalities (Zheng & Wang, 2015). One of the chief problems observed during COVID-19 pandemic was the 'digital divide' between urban and rural students to access educational information through ICT tools. In rural areas, schools have no or very limited hardware, software, internet, or technology support (Zheng & Wang, 2015). The rural-urban infrastructure disparities show that while urban areas have telecommunications, most rural areas do not, resulting in an educational disadvantage (Gulati, 2008). Lack of access to technology during the implementation of the curriculum in rural regions in the midst of COVID-19 was a significant barrier to education (Yang et al., 2021). Additionally, in their study, Clark (2015) showed that urban teachers had positive reactions towards technology integration. The findings made the following conclusions: i) urban teachers have greater confidence in their technological skills; ii) urban educators believed that technology played a crucial role in their classrooms; and iii) urban teachers wished for more technology and equipment for their classes. Alternatively, rural schools lacked teachers with comparable qualifications and levels of confidence in technological integration as urban school teachers (Clark, 2015). Herselman et al. (2020) similarly noted a shortage of skilled and experienced teachers, as well as lack of technical training in rural schools. With respect to learners, Wang (2013) stated that when compared to their urban peers, learners from rural schools score lower on internet inequality

indicators (digital access, autonomy of use, internet use self-efficacy, and social support).

2.16 Factors for Remote Learning Success

According to Matuga (2009) motivation and self-regulation are important factors in determining success in remote courses. Self-regulation is described as the "ability of students to plan, monitor, and evaluate their own behaviour, cognition and learning strategies" (Matuga, 2009, p. 5). However, Matuga (2009) also stresses that self-regulation in isolation is insufficient for success, learners must be intrinsically and extrinsically motivated to use self-regulation strategies in order to succeed in remote academic courses they are enrolled in.

Thomson (2021) stated that attempting to recreate the classroom setup in a remote setting is not always feasible. Here course creators and teachers have "to capitalize on the benefits that the remote environment can offer" and "to minimize the challenges specific to the environment" (Thomson, 2010, p. 703). The courses must be well-organized from the start, with learners receiving detailed instructions and expectations. Furthermore, teachers must anticipate potential areas of confusion and mitigate unclear directives prior to the start of the course (Thomson, 2010). Equally important, Lehmann (2012) purports that communication is the most important aspect to effective remote learning. Interaction during the course takes three forms, interaction between the student and the teacher, the student and other students, and the student and the content of the course (Savenye, 2005).

Feedback is another aspect needed for remote learning success. Responding to students in a timely manner is an important element of communication (Lehmann, 2012). Both teachers and students emphasize the value of timely and supportive feedback in developing a rapport of trust and comfort for both parties (Thomson, 2010). The influence of student-to-student interaction on community building is a recurring theme in the literature on online learning environments. Many students indicate that there is no meaningful difference in learning when comparing an online class to a face-to-face session; however, some students do recognize a difference in terms of peer interaction and community within the two environments (Kirtman, 2009).

2.17 Advantages of remote learning

Remote learning is ideal for students who prefer self-regulated learning (You & Kang, 2014). According to You and Kang (2014, p. 126), self-regulated students tend to utilize a number of "cognitive and metacognitive strategies to achieve their learning goal". Students who can self-regulate their learning skills can effectively manage their learning time, seek help from teachers, and, most importantly, they have metacognition skills for reflecting on their learning. Because it requires learners to be more engage in their studies, remote learning accelerates learner-centered learning (Mukhtar et al., 2020). Many teachers and students express that remote learning allows them to focus on course content rather than on problems associated with traditional classroom environments (Thomson, 2010). Additionally, Thomson (2010) notes that because of increased interest in and accessibility of distance learning, more public high schools now require learners to complete some remote courses as a prerequisite for high school completion.

2.18 Drawbacks of remote teaching

Despite some benefits of distance learning, Gautam (2020) suggests that distance learning can be an inefficient way of teaching. This is because it relies on technology, and because of resource constraints in many schools, distance learning is problematic and an unreliable, as compared to traditional classes. Furthermore, academic rigor has been put into question. Advocates for remote learning contend that learning is influenced by the instructional strategy embedded within the medium of delivery, implying that the quality of instruction influences learning outcomes (Rovai et al., 2005). The development of peer contact and community in traditional classroom settings as opposed to a remote learning environment is a topic that is frequently discussed. Rovai et al. (2005, p. 4) have suggested that a "strong and active social life at school can be "used to explain both high persistence and learning satisfaction"; the lack of community has been seen to lower persistence rates of remote learners. Donlevy (2003) concurs and asserts that the lack of peer interaction may have an impact on certain aspects of the learning process. While some scholars emphasize the lack of community as a problem in the remote learning environment, others argue that learner to learner interaction is less important than learner to teacher and learner to content interaction.

Another challenge of remote learning is the maintenance of motivation. Chiu et al. (2021) observed that the pandemic's accumulated stress can demotivate learners, thereby impeding learning. Learners who could not self-regulate their learning were observed not to allocate enough time to complete academic tasks, resulting in poor quality work (You & Kang, 2014). To increase success through remote learning, teachers must first understand different learning styles and learner behaviours. Furthermore, remote

learning frequently requires extensive reading and writing, which can be challenging for some learners. For example, learners with limited reading abilities may struggle with the rigorous writing and reading (Donlevy, 2003).

2.19 Challenges teachers face when engaging in remote teaching

The closure of schools due to the COVID-19 crisis necessitated remote teaching as a way to continue national school and educational activities. It was the "new normal" for education, but one in which technology played a key role to facilitate teaching and learning (Hodges et al., 2020). However, as teachers ventured into remote teaching, there was a shortfall especially in developing countries which can largely be attributed to the digital divide, with the disadvantaged having limited access to basic household services such as electricity, a lack of technology infrastructure and low level of digital literacy among both learners and teachers (UNESCO, 2020b). According to Aldarayseh (2020), challenges teachers experience in teaching science subjects online include, the absence of hands-on activities, fostering interaction in online classroom and managing learners' behaviour. Additionally, Mukhtar et al. (2020) in their studies on online learning during COVID-19 pandemic found that because of a lack of immediate feedback, teachers were unable to assess learners' levels of understanding during online lecturing.

Yusuf and Ahmad (2020) identified the following challenges that teachers faced when conducting online teaching and implementing the curriculum during COVID-19:

- Learners were observed to be less attentive throughout online instruction and learning.

- Learning platforms/mediums were deemed unsatisfactory by teachers.
- Learners lacked basic learning tools such as textbooks and computers.
- Due to internet access that was said to be poor, the teaching period had to be prolonged beyond what was originally scheduled.
- Teachers' limited access to internet interfered with class instruction.
- Some learners did not participate in online lessons.

During COVID-19 pandemic, teachers faced difficulties that went beyond pedagogical and infrastructural issues. As Cachon-Zagalaz et al. (2020) state, the pandemic not only affected learners' mental health, but teachers also experienced increased stress levels since the crisis began. Studies have reported that, teachers experienced a great deal of stress during the lockdown as a result of having to make a swift shift to online teaching (Besser et al., 2022). Ng (2007) also points out that as a result of increased workload associated with teaching from home, teachers experienced a lot of stress, frequently accompanied by symptoms of depression, anxiety, and sleep disturbance. Other studies have indicated that working from home using technological tools creates feelings of anxiety, exhaustion, tension, and lowered job satisfaction (Cuervo & Acquaro 2018).

Arkorful and Abaidoo (2015) present several disadvantages for online learning as outlined below:

i. Online learning is difficult because it lacks physical interaction, requiring increased motivation as well as time management skills to mitigate the effects of remote learning.

ii. Online learning method may be less effective than traditional method of face-to-face learning, in regard to offering of explanations and content interpretations.

iii. Online learning as a method may have negative effects in improving learner's communication skills. In this case, learners may have an academic understanding but might lack the skills needed to express their knowledge to others.

iv. Because e-learning assessment tests are administered via proxy, it is difficult to control unethical behaviour (such as cheating) by learners.

v. Online learning techniques in education are not suitable for all fields. For example, purely scientific subjects that require practical work cannot be studied thoroughly through online formats.

2.20 Challenges in Teaching Chemistry remotely

Chemistry is a subject with abstract and intricate structures, comprised of theories and concepts that necessitate clarifications with practical demonstrations (Woldeamanuel et al., 2014; Yakmaci-Guzel & Adadan, 2013). Furthermore, due to the subject's complexity, it places additional strain on teachers when teaching the subject online (Kartimi et al., 2021). According to Fautch (2019), online teaching of Chemistry gives rise to challenges such as; the inability of learners to ask questions immediately, the teacher's inability to know if each learner viewed each class in its entirety, and learners' inhibition to cooperate. Other challenges encountered in teaching Chemistry remotely include: inability to engage in practical work, assessing learners on learning outcomes, and a lack of technology tools and internet access for some teachers and learners (Okebukola et al., 2020; Shidiq et al., 2021). Mccollum et al. (2019) specified barriers that students encounter in collaborative activities in Chemistry. These include barriers beyond the teachers' control, such as Wi-Fi bandwidth and a non-responsive audience, as

well as barriers within the teachers' control, such as scheduling, and content and Chemistry language.

2.21 Teachers' perception of online classes

According to Kulal and Nayak (2020), a critical component of online education is the teacher. Teachers' levels of interest and their skills in handling online classes are important. Schmitt et al. (2012) stated that in online teaching, some teachers do not always have the competency to teach online classes. Kulal and Nayak (2020) in their survey found that teachers believed that they had confidence in their ability to conduct online classes but were not satisfied with the support and training given by the schools. The results of the study indicate that teachers administered online classes without appropriate training. According to Kulal and Nayak (2020) for increased effectiveness of online classes, teachers state that establishing guidelines for interaction and communication is necessary to ensure that learners use the learning platform appropriately and maintain awareness of expectations of them as learners. Moreover, teachers expressed dissatisfaction with their professional development in designing and arranging instructional content for online classroom management.

Kulal and Nayak's (2020) study further showed that teachers had negative perceptions towards online classes and some of the leading reasons included: "online classes will increase unemployment or reduce the demand of teachers", "online classes failed to fill the emotional attachment between teacher and learner", "without providing proper infrastructure facility it is challenging to conduct online classes" and "it is challenging to conduct online classes for practical subjects." (Kulal & Nayak, 2020, p. 10). The study

concludes that teachers were not supportive of implementing online classes in the absence of adequate training and adequate infrastructure IT facilities (Kulal & Nayak, 2020).

Orhan and Beyhan (2020) stated that a lack of experience and knowledge about online education and technical problems faced by teachers played a crucial role in online education perceptions. Low level of learner participation, teacher expectations, complexities in preparing and presenting learning materials, and being accustomed to face-to-face education were also factors that influenced teachers' perceptions of online education (Orhan & Beyhan, 2020).

Gök (2015) alludes that inadequate technological equipment and lack of knowledge must be appropriately mitigated for teachers to develop positive perceptions of online education. Other research found that teachers were less satisfied with online education since learners' attendance and involvement were lower than they had anticipated (Gök, 2015). Teachers indicated in studies on synchronous online education that learners' connection problems, as well as technical problems such as video and audio, caused learners to be distracted from the classes (Candarli & Yuksel, 2012; Grant & Cheon, 2007). According to the findings of Top et al's. (2021) study, teachers who offered compulsory courses online believed that learner participation, performance, and interest in the online classes were low. The learners' disinterest in the classes was a result of a lack of necessary tools for online education and a preference for face-to-face learning (Golladay et al., 2000).

2.22 Learners' perception of online classes

Kulal and Nayak (2020) affirm that it is the opinions of learners that matter most in the education system. According to Eastmond (1995), learners' attitude, comprehension, and mindset toward online classes are vital factors in online teaching success. It is crucial to create opportunities for sufficient interaction between the learners and the school to increase learners' motivation to learn (Levine, 2005). In their study, Kulal and Nayak (2020) asked learners about the support they received from teachers and the effects of online class on their studies. The researchers inquired into the perceptions of learners on three critical aspects such as the impact of online classes on their learning, if learners were comfortable with online learning and whether they received sufficient teacher support. The results showed that learners felt that online classes have a considerable impact on their learning style, and that they received sufficient support from their teachers in online class, such as appropriate reading material and explanations to their questions through online tools (Kulal & Nayak, 2020). However, learners did not believe that online classes were a good substitute for traditional face-to-face instruction, and they were not as comfortable with online courses as they were with face-to-face instruction.

2.23 Opportunities for education in the face of COVID-19 pandemic

According to Gautam (2020), the opportunities that can be found for education during and post COVID-19 are primarily based on distance learning. He further stresses that the key element that comes from COVID-19 in regard to education, is the difference in learning structures and layout due to social distancing protocols. However, there are

arguments that distance learning is better for high school students than traditional brick and mortar classes at schools (Gautam, 2020). Nevertheless, one of the main opportunities found in online teaching and learning is that learners can be exposed to more subjects and more qualified teachers, as distance learning allows for a wider access to education.

Additionally, online learning offers a wider range of learning styles than traditional learning, for example online platforms can be accompanied by multiple tasks that are purely web based, such as watching documentaries at a student's own pace, plus it also provides learners with eBooks without the need to return them to the library, which cannot be carried out in traditional classes (Gautam, 2020).

Furthermore, students can actively search for information to build their knowledge, and increase their level of self-reliance and discipline (Shidiq et al., 2021). Another benefit for both teachers and learners is the technical skills that increase as a result of using information technology in a knowledge-based society (Gautam, 2020). COVID-19 has led to teachers' exposition of innovative methods of delivering education through different methods of modality (Sandhu & De Wolf, 2020). Talidong and Toquero (2020) also indicated that the pandemic introduced opportunities for innovative practices in education on how to maximize education continuity in online. Therefore, there is a great confidence that the role of technology in teaching has increased because of COVID-19 pandemic.

2.24 Summary of the chapter

The chapter presented literature that served as secondary data to provide insights into the subject matter. The complexities do not only involve the infrastructure required in online learning, but also the levels of training of teachers and learners in using online learning tools. It was noted through the literature that conducting Chemistry lessons virtually is challenging due to the practical component, inefficiencies of learner participation, and difficulty in students adapting to online classes. The literature showed that challenges in online learning were not experienced in Namibia alone but in other developing as well as developed countries. Several disadvantages of online learning were presented, including the lack of instant feedback and failure to carry out experiments in practical classes as laboratories were seen as a crucial component in teaching Chemistry. The next chapter presents the research methods used in the study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research methodology employed to investigate the challenges Chemistry teachers faced in implementing the new NSSCO Chemistry curriculum in the Otjozondjupa Region during the COVID-19 national lockdown. According to Fraenkel et al. (2012), research methodology is the systematic theoretical analysis of the methods applied to a field of study. This chapter outlines the research design, population and participants in the study, the sampling procedures as well as the research instruments used to collect data. It also discusses data collection procedures, pilot study, the issues of validity and reliability, and the data analysis techniques. Finally, it clarifies the ethical consideration in this research.

3.2 Research Design

Maree (2016) describes research design as a strategy that moves the underlying philosophical assumptions to specify participant selection, data collection methods, and data analysis. McMillan and Schumacher (2014, p. 28) defined a research design as "the procedures for conducting the study, including when, from whom, and under what conditions the data will be obtained". Moreover, they pointed out that a sound research design should produce results that are credible and valid. This concurs with Polit and Hungler (1999) who also believe that the research design can be regarded as a blueprint or outline for carrying out the study in such a way that maximum control over factors that could interfere with the validity of the research results is exercised. Furthermore, Creswell (2014) indicates that research design refers to various types of inquiry and/or

inquiry strategies in which quantitative, qualitative, or mixed methods can be used during research.

It is important to select a viable method that will enable data collection and analysis that can address the research problem (Leedy & Ormord, 2005). Furthermore, the research design is determined by the nature of the problem to be investigated as well as the methods of data collection. This study therefore followed a mixed methods approach as it permits the participants to describe the challenges; they faced in implementing the new NSSCO Chemistry curriculum during the COVID-19 national lockdown. A mixed methods approach is described as the "empirical research that involves the collection and analysis of both qualitative and quantitative data" (Almalki, 2016, p. 291). A mixed methods design was appropriate for this study because it combined the strengths of quantitative and qualitative data and provided a better understanding of the research problem than either one alone (Creswell, 2014; Pluye & Hong, 2014). Greene et al. (2012) identified five reasons for using mixed methods research: complementarity, triangulation, initiation, development, and expansion. The purpose of using mixed methods in this study was complementarity, in which findings from qualitative data were used to explore and enhance findings from quantitative data (Combs & Onwuegbuzie, 2010).

An explanatory sequential mixed methods design was adopted, which according to Creswell and Plano (2011) is an approach in which quantitative data is collected first, and analysed, followed by qualitative data collection and analysis which helps explain and elaborate the quantitative findings. They further stated that combining the two methods allows the researcher to gain a deeper understanding of the research problem

rather than using either approach alone. Consistent with this definition, Ivankova et al. (2006) share the same sentiment as they stipulated that the basis of using an explanatory sequential design is that the results from quantitative data provide a general picture of the research problem while the results from qualitative data refine, explain or extend the general picture. In addition, a mixed methods approach provides more comprehensive data analysis and compensates for limitations with a single method (McMillan & Schumacher, 2010). The diagram below illustrates the sequential flow of the quantitative and qualitative phases.

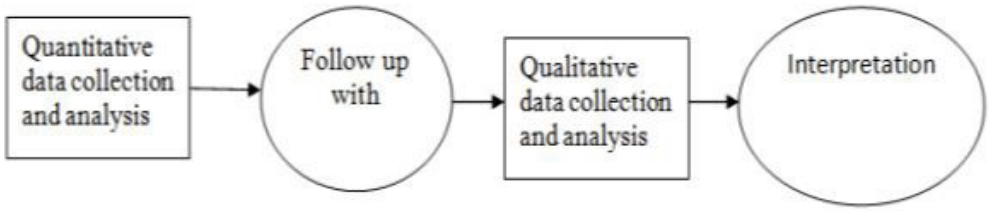

Figure 2: Explanatory Mixed Methods approach

Source: Adopted from Creswell and Plano Clark (2007).

Figure 2 depicts the sequential explanatory mixed methods design described earlier. It involves the collection and analysis of quantitative data followed by the collection and analysis of qualitative data and both data are interpreted. Qualitative data refine the results from the quantitative data by exploring a few typical cases, probing key results with increased scrutiny done by conducting follow-up interviews (Creswell, 2014; Steven, 2012).

As elucidated earlier, the study followed an explanatory sequential mixed methods approach which is comprised of two phases. Hence, in this study the researcher used two

separate phases sequentially to answer the research questions. In the first phase of the study, the researcher collected quantitative data using a questionnaire. In the second phase, the researcher collected qualitative data using semi-structured interviews to gain insight and in-depth understanding of the quantitative data gathered in the first phase of the study. The researcher believes that the account of these phases aligns with McMillan and Schumacher's (2010, p. 401) perspective of using explanatory design that "when quantitative data collection is clearly warranted and follow-up analysis – especially, using qualitative methods – is necessary to elucidate the quantitative findings".

3.3 Population and Sample

3.3.1 Population

Creswell (2006) defines a population as a group of people with common features that the researcher is interested in studying and from which a study sample is taken for exploration. Additionally, participants in the population must share at least one characteristic that qualifies them as population members (Asiamah et al., 2017). The population for this study comprised of all Grade 10 and 11 Chemistry teachers in Otjozondjupa Region. At the time of the study, there was a total number of 32 Grade 10 and 11 Chemistry teachers at 21 secondary schools offering Chemistry in Otjozondjupa Region (Ministry of Education, Arts and Culture, 2021). The researcher chose Grade 10 and 11 Chemistry teachers as they were presumed to be rich in information required to answer the research questions.

3.3.2 Sample and sampling procedure

De Vos et al. (2011) define a sample as the elements of the population that are taken into account for inclusion in the study. For the first phase of the study, a type of purposive sampling technique known as total population sampling, was adopted to select all (32) Grade 10 and 11 Chemistry teachers in the region to complete the questionnaire. Purposive sampling is a non-probability method in which elements or participants for the sample are chosen based on the researcher's judgment (Mertens, 2009). This sampling method was deemed necessary as it enabled the researcher to select participants who were most likely to provide appropriate data in terms of relevance and depth, and these are teachers who are actually teaching Chemistry to Grade 10 and 11 leaners. McMillan and Schumacher (2014) state that purposive sampling permits the researcher to choose specific elements from the population that are representatives or are likely to be informative about the topic of interest. This concurs with Johnson and Christensen (2012, p. 231) who suggest that in "purposive sampling the researcher specifies the characteristics of the population of interest and locates individuals with those characteristics".

After the quantitative data were analysed, the researcher purposively selected 12 teachers for the second phase of the study. These teachers were selected from the original sample of those who had completed the questionnaire during the first phase. The teachers were selected on the following basis: a teacher who holds at least a Diploma in Education majoring in Chemistry or Physical Science; and a teacher who has a minimum of 4 years teaching experience.

3.4 Research Instruments

The study used two instruments namely, a questionnaire and an interview guide.

3.4.1 Questionnaire

McMillan and Schumacher (2014, p. 5) defined a questionnaire as "a written set of questions or statements that is used to assess attitudes, opinions, beliefs, and biographic information". A questionnaire (see Appendix A) was used in the first phase of the study and was divided into three sections: Section A, dealt with teachers' biographic information; Section B consisted of close-ended questions to collect statistical data for research question one and two, which were to determine the challenges Chemistry teachers experienced as well as to get their views on the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown.

3.4.2 Interview Guide

An interview guide (see Appendix B) consisting of open-ended questions was used in the second phase of the study. Creswell (2015) defines an interview as a dialogue whose goal is to gather details about the interviewee's real world in order to understand the meanings of the described phenomenon. Interviews, according to Maree (2016) and Turner (2010) are the main data collection for qualitative research as they provide in-depth information about the experiences, thoughts, beliefs, understandings, attitudes and behaviors of the participant regarding a phenomenon. Furthermore, when conducted correctly, interviews are a valuable source of information because they aim to see the world through the participants' eyes. Generally, interviews can be structured, semi-

structured and unstructured (Cohen et al., 2011). For this study, semi-structured interviews were used to provide the researcher with detailed explanations on the research questions. Teachers were asked to elaborate on their responses to the questionnaire on the challenges they experienced and on their views regarding the implementation of the new NSSCO Chemistry curriculum during the national lockdown. The teachers were also asked to give possible strategies that would help the new NSSCO Chemistry curriculum to be implemented effectively during the lockdown. The researcher chose to use semi-structured interview as it is a flexible and more practical way of collecting data as phrasing can be modified and clarifications be given (Turner, 2010). On top of that, with semi-structured interviews, there is usually a pre-interview guide that "provides a clear set of instructions for interviewer and can provide reliable, comparative qualitative data" (Cohen & Crabtree, 2006, p. 1). In this instance, an interview guide was utilized to help cover all relevant areas of the research questions. Furthermore, interviews are more powerful in collecting narrative data compared to other methods, because it is a more intrusive form of data collection that allows the researcher to investigate participants' views in greater depth (Millar et al., 1999). Moreover, the researcher used probes to gain clarity on participants' responses and to get extra information (Johnson & Christensen, 2012). Interviews were conducted face-to-face, on a one-on-one basis and were audio recorded to provide a detailed report. Each interview lasted for about 35- 45 minutes.

3.5 Pilot Study

A pilot study, also known as a feasibility study, is a pre-testing of a specific research tool, such as a questionnaire or an interview guide (Platton, 1990). The questionnaire

and interview guide were pilot tested with five Grade 10 and 11 Chemistry teachers in four secondary schools in Khomas Region for both the content and construct validity. After the preliminary data analysis of the quantitative data, the researcher purposively selected five Chemistry teachers from the group of the teachers that completed the questionnaire, to be interviewed. The aim was to check for reliability and validity of both, the questionnaire and interview guide. According to Yusof and Ali (2011) reliability (consistency) and validity (accuracy) are the key aspects in defining and assessing bias and distortion, and to determine the trustworthiness of the research. Furthermore, Muzah (2011) states that a pilot study is conducted to: improve both validity and reliability; ensure that the questions mean the same to all participants; estimate the length of time it will take the participants to respond to the questions; check that all of the questions and instruments are concise and clear, and that there are no biased items. Adding to this, McMillan and Schumacher (2014) state that a pilot study also provides an initial idea of the possible types of responses and whether revisions are required to avoid the ceiling or floor effect. A pilot study has the advantage of providing early warnings of possible failure of the main study, indicating where the research tools may not be followed, or whether proposed methods and instruments are inappropriate or overly complex (Platton, 1990).

During the pilot study, quantitative data were first collected and descriptively and statistically analysed, thereafter qualitative data were collected and thematically analysed. The process of conducting the pilot study was completed within a period of two weeks. Preliminary results from the pilot study indicated that participants

understood the items in the research instruments as they answered the questions accordingly, therefore there was no need to revise or adjust the questions.

3.6 Validity and reliability of the research instruments

According to Ary et al. (2014, p. 242) validity (trustworthiness) is defined "as an extent to which an instrument measured what it claims to measure". Whereas, reliability of an instrument "is the degree of consistency with which it measures whatever it is purported to measure" (Ary et al., 2014, p. 253). This explanation suggests that if the same instrument is used under similar conditions or administered to participants from the same group, the results should be of comparable quality. Therefore, the research instruments were given to the researcher's supervisor for expert judgment, who then made corrections and provided relevant suggestions to ensure their validity and reliability. The supervisor's comments and suggestions were incorporated into the final instruments, which were then pilot tested. This was done to ensure that the research tools covered the topics under investigation.

3.7 Data Collection Procedures

Upon permission being granted to collect data at the schools, the researcher first administered questionnaire to the 32 Chemistry teachers during the first phase of the study. The questionnaires were collected after one to two days, and the quantitative data were analyzed. The teachers' biographic information was used in the selection of the 12 participants for the second phase of the study. Thereafter, the researcher conducted interviews in the second phase of the study, with the 12 purposively selected Chemistry teachers in the participants' settings during their administrative periods and after school.

3.8 Data Analysis

Data analysis is the process of reviewing, cleaning, transforming, and modeling data in order to determine useful information, make decisions, and support the decision-making process (Bryman, 2008). Since the study followed an explanatory sequential mixed method, data analysis for this study followed two distinct phases.

Phase 1*:* The quantitative data collected from the questionnaire were analyzed using descriptive statistics such as frequencies and percentages (Creswell, 2006) and presented in graphs and tables. The analysis identified general characteristics among the participants' responses to the questions on challenges and their overall experiences regarding the implementation of the new NSSCO Chemistry curriculum during COVID-19 national lockdown.

Phase 2*:* The second phase focused on analyzing qualitative data that helped provide a more in-depth insight into the quantitative data. Coding and thematic analysis were used to analyse the qualitative data, whereby main occurrence of responses from the teachers were noted and gathered to create patterns, themes and categories (Creswell, 2009). The researcher first transcribed verbatim the audio recording into text data. The researcher read through the transcript numerous times, allocating preliminary codes, generated data into categories and used research questions to guide the development of themes. The findings from interviews are analysed and presented in chapter 4 in line with the literature review.

3.9 Research Ethics

The researcher first applied for an ethical clearance certificate from the University of Namibia's Research Ethical Committee, which was submitted to the Director of Center for Research Services to obtain a Research permission letter. Thereafter, the researcher wrote a letter to the Executive Director in the Ministry of Education, Arts and Culture requesting permission to conduct the study. Permission was also sought from the Director of Education for Otjozondjupa Region, Circuit Inspectors, and the secondary schools' principals. Permission was granted in all requests described above.

Before collecting the data, the purpose of the study was clearly explained to the participants and the researcher first obtained informed consent from participants. Furthermore, participants were informed that information will be given voluntarily and that they could withdraw from the study anytime. Permission to audio-record was sought and obtained from the participants. Confidentiality of the collected data was insured by locking all collected data in a safe cabinet to which only the researcher has a key and data will be destroyed after 5 years. To ensure anonymity, codes were given to both the participants and the schools to conceal their names or identity.

3.10 Summary of the chapter

This chapter provided an overview of the research methodology used in the study. It presents the research design used to gather and analyse the data. It includes the target population and the sampling that was used. Furthermore, the chapter described the research instruments employed to collect data. Other issues discussed include, pilot study and the aspects of reliability and validity of the data collection tools. It explained

the data collection procedure, data analysis and provided clarity on the issue of ethical consideration for the study.

CHAPTER 4: DATA ANALYSIS AND PRESENTATION

4.1 Introduction

The study investigated challenges Chemistry teachers faced in the implementation of the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown. This chapter discusses and analyses results obtained from the questionnaires and interviews administered to the participants in response to answer the research questions of the study. It begins by giving a list of coded names given to the teachers and schools in the study. Secondly, the chapter presents the biographic information of the teachers who participated in the study. Thirdly, the chapter presents the analysis of quantitative data obtained from the questionnaires, followed by the analysis of qualitative data obtained from the interviews. The results from the questionnaires are presented in frequency tables and the results obtained from the interviews are presented according to the themes and sub-themes derived from the research questions of the study.

A total number of 28 teachers from the 32 grade 10 and 11 Chemistry teachers in Otjozondjupa Region who were given the questionnaires responded and returned them while four did not return them. Table 1 presents a list consisting of the coded names of the secondary schools and teachers who participated in the study. The Chemistry teachers and their schools were given coded names to hide their identities and protect them from any harm.

Table 1

The coded Chemistry teachers who participated in the study and their respective schools

School name	Names of teachers
School A	Teacher 1, Teacher 2
School B	Teacher 3
School C	Teacher 4, Teacher 5
School D	Teacher 6
School E	Teacher 8, Teacher 9
School F	Teacher 10, Teacher 12
School G	Teacher 13
School H	Teacher 14
School I	Teacher 15
School J	Teacher 16
School K	Teacher 17, Teacher 18
School L	Teacher 19
School M	Teacher 20, Teacher 21
School N	Teacher 22
School O	Teacher 23
School P	Teacher 24
School Q	Teacher 26
School R	Teacher 28
School S	Teacher 29
School T	Teacher 30, Teacher 31
School U	Teacher 32

Source: Field data, 2021

4.2 Biographic Information

4.2.1 Gender

The gender distribution of teachers in the study is shown in Table 2.

Table 2

Gender distribution of the Chemistry teachers

Gender	**Frequency**
Males	9
Females	19
Total	**28**

The results in Table 2 indicate that most participants in the study, 19 (68%) were female and only nine (32%) were male.

4.2.2 Teachers' teaching qualifications

The qualifications of the teachers are summarised in Table 3.

Table 3

Qualifications of Chemistry teachers

Qualifications	**Frequency**
A.C.E in Physical Science	5
Teaching Diploma in Physical Science	10
Education degree in science	15
Bachelor of Science	2
Master's degree in Science Education	1

Key: A.C.E.: Advanced Certificate in Education

The data in Table 3 indicate that all participants had some types of qualifications in science. The leading qualification was an education degree in science, with 15 of the participants holding this qualification. The next common qualification was a Teaching

Diploma in Physical Science with 10 participants holding this qualification. Only two teachers held a Bachelor's degree in science and one teacher held a Master's degree in Science Education. Some teachers indicated having more than one qualification. Other qualifications that were mentioned include a Basic Education Teachers' Diploma.

4.2.3 Teaching Experience

The teachers' years of teaching experiences are summarised in Table 4.

Table 4

Chemistry teachers' years of teaching experience

Teaching experience (Years)	**Frequency**
0-3	6
4 - 6	7
Above 6	15
Total	**28**

Data in Table 4 illustrates that the majority, 15 (54%) of the participants had more than six years teaching experience, seven (25%) had between 4-6 years teaching experience, while six (21%) had between 0-3 years teaching experience. Most participants representing 12 (79%) had been teaching for more than four years which implies that most participants had sufficient experience in curriculum implementation.

4.2.4 Teachers' subjects of specialization

Teachers where asked whether Chemistry was the subject of their specialization, and the results obtained are shown in Table 5.

Table 5

Teachers' subjects of specialization

Yes	24
No	4
Total	**28**

From Table 5, the results reveal that most of the participants, 24 (86%) had Chemistry as their subject of specialization, while four (14%) indicated that Chemistry was not their subject of specialization. This means that some teachers responsible for Chemistry have not majored in Chemistry. This also implies that these Chemistry teachers might not possess requisite competencies for implementing the Chemistry curriculum. Kigwilu and Githinji (2015) noted that to guarantee effective implementation of a curriculum, having qualified teachers is imperative, as it assures clear and convincing explanations of Chemistry facts, concepts, principles and theories to the learners (Orado, 2009).

4.2.5 Number of Subjects taught by the teachers

Table 6 shows the number of subjects taught by the Chemistry teachers.

Table 6

Number of subjects taught by Chemistry teachers

Number of subjects	**Frequency**
1 Subject	8
2 Subjects	15
3 Subjects	5
Total	**28**

Table 6 shows that five (18%) of the participants taught three subjects, this means that in addition to Chemistry, they taught two other subjects. Furthermore, 15 (54%) of the

teachers indicated two subjects while eight (29%) stated that they only taught one subject, this being Chemistry.

4.2.6 Average number of learners in the Chemistry classes

The average number of learners in the Chemistry classes is presented in Table 7.

Table 7

Number of learners in the Chemistry classes

Number of learners	Frequency
Less than 20	0
21 – 30	4
31 – 40	18
41 – 50	5
More than 50	1
Total	**28**

The data in Table 7 indicate that the majority, 18 (64%) of the participants had between 31-40 learners in their Chemistry classes, five (18%) had between 41-50 learners in a class, four (14%) had between 31-40 learners and one (4%) of the participants had the largest number of learners comprised of more than 50 learners in a class. The information reveals that the teacher-learner ratio in most Chemistry classes is higher than the prescribed teacher-learner ratio in Namibian secondary schools, which is 30 learners per teacher (Ministry of Education, 2013).

4.2.7 Teachers' school location

The schools' locations of the Chemistry teachers are shown in Figure 3.

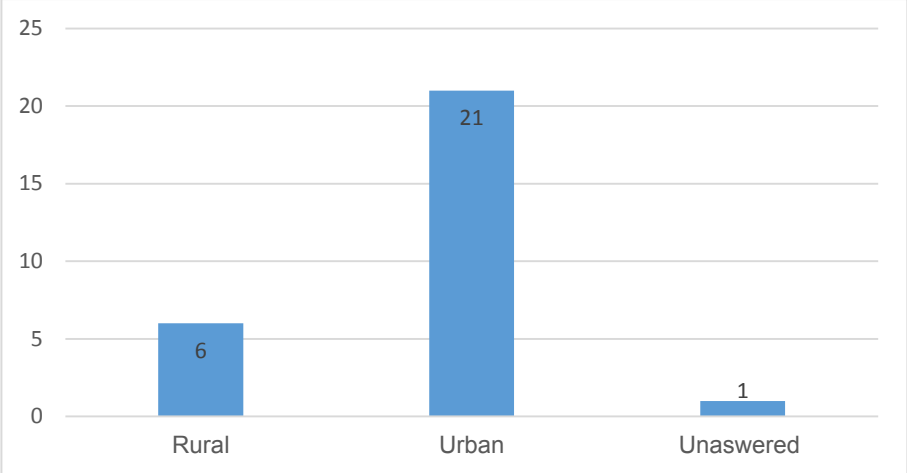

Figure 3: Teachers' school location

Note: Number of schools located in rural area =6, Urban area =21, Total = 27

Data in Figure 3 indicates that the majority, 21 (75%) of the participants' schools in the study were in urban areas while six (21%) of the participants' schools were located in rural areas. One (4%) participant did not indicate the location of the school.

4.2.8 Availability/ unavailability of facilities at the schools

Chemistry teachers were asked to indicate the availability or unavailability of facilities at their schools to aid the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown. Their resultant information is presented in Table 8.

Table 8

Availability/ unavailability of facilities at schools

Facilities	Available	Unavailable
Equipped science laboratory	9	19
Computer laboratory	22	6
School library	24	4
Internet connectivity	23	5
Electricity	28	0
Photocopying machine	28	0

The data from Table 8 reveals that the majority, 19 (68%) of the participants did not have equipped science laboratories, however, nine (32%) of the teachers had equipped science laboratories for practical work at their schools. (Mudulia, 2012) asserted that a lack of functioning science laboratories leads to low performance at schools. Table 8 also shows that 22 (79%) of the participants had computer laboratories, while six (21%) reported an absence of computer laboratories at their schools. Furthermore, the results show that 24 (86%) of the participants had school libraries while four (14%) did not have libraries at their schools. Additionally, 23 (82%) of the teachers indicated having internet connectivity, while five (18%) stated that they did not have internet connectivity. As would be expected, most of the rural schools did not have internet connectivity and only a few of the rural schools had internet. All participants reported having electricity and photo copying machines at their schools.

4.3 Results from the questionnaires

As stated in the preceding chapter, a total of 32 questionnaires were distributed to all Grade 10 and 11 Chemistry teachers in Otjozondjupa Region. Of the 32 questionnaires handed out, 28 questionnaires were completed and returned, while four were not returned.

4.3.1 Challenges experienced by Chemistry teachers in the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown

Table 9 shows participants' responses on the nine statements that required them to indicate their levels of agreement regarding the challenges experienced in the implementation of the new NSSCO Chemistry curriculum during COVID-19 national lockdown. A five-point Likert Scale was used, using Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), and Strongly Agree (SA).

Table 9

Challenges experienced when implementing the new NSSCO Chemistry curriculum

Statements	**SD**	**D**	**U**	**A**	**SA**	**Total**
Chemistry teachers were not prepared to implement the new NSSO Chemistry curriculum virtually.	1	3	3	14	7	28
Chemistry teachers lacked skills in utilizing technological devices in remote teaching.	1	4	4	13	6	28
Chemistry teachers felt overwhelmed with work in implementing the new NSSO Chemistry curriculum virtually.	1	3	2	17	5	28

There was a lack of technological devices and internet connectivity for the teachers.	1	3	4	16	4	28
There was a lack of technological devices and internet connectivity for the learners.	2	4	2	17	3	28
Every learner has equal cognition to receive virtual teaching	6	16	3	2	1	28
The Chemistry teachers lacked the competencies in fostering interaction with the learners during remote teaching.	4	7	2	10	5	28
A lack of hands-on activities and experiments hindered effective teaching and learning of Chemistry during the lockdown.	2	3	2	15	6	28
Remote teaching and learning have created new cost burdens for the learners and their parents.	1	3	2	16	6	28

Chemistry teachers were not prepared to implement the new NSSCO Chemistry curriculum virtually

The results in Table 9 indicate that most Chemistry teachers, 21 (75%) agreed with the statement "chemistry teachers were not prepared to implement the new NSSCO Chemistry curriculum virtually". Of the 21 Chemistry teachers, seven (25%) of the teachers strongly agreed and 14 (50%) agreed. Three (11%) of the teachers disagreed, one (4%) strongly disagreed while three (11%) teachers were undecided on the statement. According to the literature reviewed, teachers' readiness to implement a curriculum is pivotal and a lack of preparedness results in ineffective curriculum implementations (McNeill et al., 2016).

Chemistry teachers lacked skills in utilizing technological devices in remote teaching

The responses to the second statement in Table 9 shows that, 19 (68%) agreed that they lacked skills in utilizing technological devices in remote learning. Six (21%) of the teachers strongly agreed and 13 (46%) agreed with the statement. Four (14%) of the teachers disagreed, one (4%) strongly disagreed, while four (14%) of the teachers were undecided on the statement. From the findings, most teachers felt that they did not have the skills needed in utilizing technological devices in remote teaching. The results agree with Makoe (2016), who suggest that teachers lacked knowledge and skills to use digital technology for pedagogical purposes and this resulted in barriers to their technological integration in teaching. This problem may have been as a result of some teachers not being accustomed to using technology in their teaching, and only started experimenting with the new method during the COVID-19 (Bonk, 2020).

Chemistry teachers felt overwhelmed with work in implementing the new NSSCO Chemistry curriculum virtually

When Chemistry teachers were asked whether they felt overwhelmed with work while implementing the new NSSCO Chemistry curriculum virtually, most teachers, 22 (79%) agreed to this assertion. Out of the 22 teachers, five (18%) of the teachers strongly agreed and 17 (61%) agreed. Three (11%) teachers disagree, one (4%) strongly disagreed and the remaining one (4%) was undecided on the claim.

There was a lack of technological devices and internet connectivity for the teachers

In response to whether there was a lack of technological devices and internet connection for teachers, in total, 20 (71%) were in an agreement with the statement. Of the 20

teachers, four (14%) agreed, and 16 (57%) of the teachers strongly agreed with the statement. On the other hand, three (11%) of the teachers disagreed with this assertion, one (4%) strongly disagreed while four (14%) were undecided. In their study, Yusuf and Ahmad (2020) found that teachers' internet access was generally poor during distance learning, causing disruption to learning time during COVID-19.

There was a lack of technological devices and internet connectivity for the learners

When teachers were presented with the statement "there was a lack of technological devices and internet connection for the learners", three (11%) of the teacher strongly agree with this statement, 17 (61%) agreed, four (14%) disagreed, two (7%) strongly disagreed, while two (7%) of the teachers were undecided. The results revealed that majority of the teachers, 20 (71%) in total, agreed with this statement. This concurred with findings of the study of Yusuf and Ahmad (2020) who noted that learners lacked basic learning tools to enable remote learning, such as laptops and books, which was viewed as a barrier to learning.

Every learner had equal cognition to receive virtual teaching

With regard to the teachers' views whether every learner had equal cognition to receive virtual teaching, 22 (79%) of the teachers disagreed with the statement, with six (21%) of the teachers strongly disagreeing and 16 (57%) disagreeing with this claim. Two (7%) of the teachers agreed, one (4%) strongly agreed, while three (11%) of the teachers were undecided. This is strongly supported and asserted by Dhawan (2020) that not all students have access to digital devices, the internet, and WI-FI, which presents difficulties because many students may miss out on learning. Furthermore, remote

learning typically involves a lot of reading and writing, which may be challenging for some leaners (Donlevy, 2003).

Chemistry teacher lacked the competencies in fostering interaction with the learners during remote teaching

With the regard to whether Chemistry teachers lacked the competencies in fostering interaction with the learners during remote learning, in total 15 (54%) of the teachers agreed with this statement. Of the 15 teachers, five (18%) of the teachers strongly agreed and 10 (36%) agreed with the statement. Seven (25%) of the teachers disagreed, four (14%) strongly agreed, while three (11%) were undecided. Herselman et al. (2020) noted that a lack of training for teachers in communication remains a challenge. To support this, Nashilongo (2020) stated that learner access to education and learning was a problem during remote teaching in Namibia.

A lack of hands-on activities and experiments hindered effective teaching and learning of Chemistry during the lockdown

The results in the Table 9 further show that many teachers 21 (75%) agreed that a lack of hands-on activities and experiments hindered effective teaching and learning. This includes six (21%) teachers strongly agreeing and 15 (53%) agreeing. Three (11%) of the teachers disagreed, two (7%) strongly agreed, while two (7%) of the teachers were undecided. Childers and Jones (2017) posit that a lack of practical hands-on tasks in remote learning leaves students with a gap in scientific experimentation.

Remote teaching and learning have created new cost burdens for the learners and their parents.

Similarly, 22 (79%) teachers agreed with the statement "remote teaching and learning has created new cost burdens for the learners and their parents". Of the 22 teachers, six (21%) of the teachers strongly agreed and 16 (57%) agreed. Three (11%) of the teachers disagreed and one (4%) strongly agreed, while two (7%) of the teachers were undecided.

4.3.2 Views of Chemistry teachers on the implementation of the NSSO Chemistry curriculum during the COVID-19 national lockdown

Chemistry teachers were asked to give their views regarding how they felt about the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown. Yes or No answers were requested from participants and the findings are presented in Table 10.

Table 10

Confidence of Chemistry teachers regarding new Chemistry curriculum implementation

Statements	**Yes**	**No**	**Total**
I am satisfied with the way the Chemistry curriculum was implemented through remote teaching during the national lockdown.	3	25	28
The implementation of the Chemistry curriculum during lockdown has assisted in improving learners' learning.	4	24	28
I found the remote teaching of Chemistry to be unfulfilling.	23	5	28
The implementation of the Chemistry curriculum through remote teaching was demanding in terms of my time, energy, planning	26	2	28

and teaching.			
I felt insecure about implementing the Chemistry curriculum through remote teaching.	22	6	28

I am satisfied with the way the Chemistry curriculum was implemented through remote teaching during the national lockdown

The results in Table 10 revealed that majority, 25 (89%) of the Chemistry teachers were not satisfied with the way the chemistry curriculum was implemented through remote teaching during the national lockdown. Only three (11%) teachers were satisfied with the implementation.

The implementation of the Chemistry curriculum during lockdown has assisted in improving learners' learning

On the statement, whether the implementation of the Chemistry curriculum during the lockdown has assisted in improving learners' learning, more teachers 24 (86%) believed it did not improve learning and only (14%) four believed that it did.

I found remote teaching to be unfulfilling

When teachers were asked to indicate whether they found remote teaching to be unfulfilling or vice versa, 23 (82%) of the teachers indicated that they felt unfulfilled while only five (18%) said that they felt fulfilled. Kulal and Nayak (2020) in their study found that teachers had a poor opinion regarding online classes.

The implementation of the Chemistry curriculum through remote teaching was demanding in terms of my time, planning and teaching

In responses to the statement "the implementation of the Chemistry curriculum through remote teaching was demanding in terms of my time, energy, planning and teaching", 26

(93%) teachers indicated a positive answer and only two (7%) of the teachers did not view the implementation as demanding. These findings agree with the view of Chandra and Sharma (2018) who stated that teachers spend a significant amount of time planning lessons and developing appropriate learning resources for the target group when teaching science subjects online. Furthermore, the complexity of Chemistry requires teachers to work harder in order to fulfil their remote teaching duties. (Shidiq et al., 2021).

I felt insecure about implementing the Chemistry curriculum through remote teaching

Table 10 further shows that 22 (79%) of the Chemistry teachers felt insecure in implementing the Chemistry curriculum through remote teaching, while six (21%) reported to have felt secured. Orhan and Beyhan (2020) state that teachers' lack of experience and knowledge about online education, as well as technical issues, played a significant role in their negative perceptions of online education.

4.3.3 Views of Chemistry teachers on the preparedness to implement the new NSSCO Chemistry curriculum during the COVID-19 national lockdown

Table 11 presents the teachers' responses on the four statements regarding their preparedness to implement the new NSSCO Chemistry curriculum during the COVID-19 national lockdown. A five-point Likert scale was used, using Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), and Strongly Agree (SA) was given to the teachers to indicate their levels of agreement with each statement.

Table 11

Preparedness of teachers when implementing the new NSSCO Chemistry curriculum

Statements	**SD**	**D**	**U**	**A**	**SA**	**Total**
I had used technological devices in teaching Chemistry prior to the lockdown.	3	8	1	9	7	28
I had prior knowledge regarding remote teaching.	3	6	2	11	6	28
I received helpful guiding policies on how to conduct remote teaching of Chemistry.	5	9	1	10	3	28
I received sufficient in-service training in content knowledge and teaching methods before the remote implementation of the new Chemistry curriculum.	5	8	1	11	3	28

I had used technological devices in teaching Chemistry prior to the lockdown

The findings from Table 11 reveal that in total, 16 (61%) of the Chemistry teachers had used technology devices in teaching Chemistry prior to the lockdown. Out of the 16 teachers, seven (25%) strongly agreed and nine (32%) agreed. Meanwhile, eight (29%) teachers disagreed with the statement, three (11%) strongly disagreed while 1(4%) teacher was undecided.

I had prior knowledge regarding remote teaching

Table 11 further reveals that a total of 17 (61%) of the Chemistry teachers had prior knowledge regarding remote teaching before the lockdown. Of the 17 teachers, six (21%) of the teachers strongly agreed and 11 (39%) of the teachers agreed. Additionally, nine (32%) of the teachers disagreed and three (11%) strongly disagree with the statement, while two (7%) of the teachers were undecided.

I received helpful guiding policies on how to conduct remote teaching of Chemistry

On the third statement, the data in Table 11 shows that in total, 14 (50%) of the Chemistry teachers did not receive helpful guiding policies on how to conduct remote teaching of Chemistry. Of the 14 teachers, five (18%) strongly disagreed and 9 (32%) disagreed. Ten (36%) of the teachers agreed, three (11%) strongly agreed, while one (4%) teacher was undecided. Offir et al. (2003) stressed that a lack of support and guiding policies made remote teaching difficult for teachers.

I received sufficient in-service training in content knowledge and teaching methods before the remote implementation of the new Chemistry curriculum

In response to the statement whether Chemistry teachers received sufficient in-service training in content and teaching methods before the remote implementation of the new NSSCO Chemistry curriculum, a total of 14 (50%) teachers agreed with the statement. This includes three (11%) teachers strongly agreeing and 11 (39%) agreeing, while one (4%) was undecided on the statement. In their study, Kulal and Nayak (2020) found teachers to be dissatisfied with the support and training provided by the schools. Their findings also indicate that teachers delivered online classes without or with little training. It is important to note that teachers' technological knowledge must be increased for them to develop positive perceptions of online education and effectively conduct classes (Gök, 2015).

4.3.4 Views of Chemistry teachers regarding learners' abilities and attitudes toward the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown

Table 12 shows teachers' responses on the four statements about how they viewed learners' abilities and attitudes towards the implementation of the new NSSCO Chemistry curriculum during the Covid-19 national lockdown. A five-point Likert Scale was used, using Strongly Disagree (SD). Disagree (D), Undecided (U), Agree (A), Strongly Agree (SA).

Table 12

Learners' abilities and attitudes toward the implementation of the new Chemistry curriculum

Statements	SD	D	U	A	SA	Total
Learners studying Chemistry showed eagerness to continue learning during the lockdown	8	12	3	3	2	28
Learners were completing and submitting the activities given to them during the lockdown	6	11	4	5	2	28
Learners struggled to understand the content of Chemistry through remote teaching and learning	2	3	3	15	5	28
Learners felt isolated in their learning during lockdown	1	3	3	18	3	28

Learners studying Chemistry showed eagerness to continue learning during the lockdown

Table 12 shows that in total, 20 (71%) of the teachers disagreed with the statement that learners showed eagerness to continue learning during the lockdown. Of the 20 teachers, eight (29%) teachers strongly disagree and 12 (43%) disagree. Three (11%) teachers

agreed, two (7%) strongly agreed, while three (11%) of the teachers were undecided. These results agree with the findings of Yusuf and Ahmad (2020) who observed that during COVID-19 remote learning, some learners did not pay attention during online teaching and learning. The reason could be that learners did not believe that online classes were as good as traditional face-to-face instruction, and they were not as comfortable with online courses as they were with face-to-face instruction (Kulal & Nayak, 2020).

Learners were completing and submitting the activities given to them during the lockdown

In total, 17 (61%) of the teachers disagreed that learners were completing and submitting the activities given to them. Of the 17 teachers, six (21%) of the teachers strongly disagreed and 11 (39%) disagreed with the statement. Five (18%) of the teachers agreed, two (7%) strongly agreed, while four (14%) of the teachers were undecided. Gök (2015) be in accordance with these results that learners' attendance and engagement in online learning were lower than expected, leading to dissatisfaction with online education.

Learners struggled to understand the content of Chemistry through remote teaching and learning

A total of 20 (71%) Chemistry teachers agreed with the statement “learners struggled to understand the content of Chemistry through remote teaching and learning”. Of the 20 teachers, five (18%) strongly agreed and 15 (54%) agreed. Three (11%) teachers disagreed, two (7%) strongly disagreed, while three (11%) teachers were undecided. Most teachers agreed that learners struggled to understand the content of Chemistry through remote teaching and learning. Understanding Chemistry content without face-

to-face classes is difficult because Chemistry is a subject with complex concepts, theories, and calculations that necessitate hands-on activities to create meaningful learning (Shidiq et al., 2021).

Learners felt isolated in their learning during lockdown

A total of 21 (75%) teachers agreed that learners felt isolated in their learning during lockdown, with three (11%) strongly agreeing and 18 (64%) agreeing. Three (11%) of the teachers disagreed with the statement and one (4%) strongly disagreed, while one (4%) teacher was undecided. Most teachers (75%) agreed that learners felt isolated in their learning during lockdown. This is supported by Levine (2005) who found that an informal environment in remote learning reduced student motivation, and that a lack of contribution from other students reduced learners' insights.

4.3.5 Views of Chemistry teachers on the parental involvement and support toward the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown

Table 13 presents the responses on the four statements regarding the views of Chemistry teachers on parental involvement and support towards the implementation of the new NSSCO Chemistry curriculum during the lockdown. Teachers were asked to indicate their responses by choosing N= Never, S= Seldom, SO = Sometimes, O= Often, AA= Almost Always to each statement.

Table 13

Parental involvement and support toward the implementation of the new Chemistry curriculum

Statements	N	S	SO	O	AA	Total
Parents assisted their children with learning during remote teaching	12	10	5	1	0	28
Parents were actively involved in their children's' education	11	13	1	2	1	28
Parents were eager to obtain information about their children's progress from the teacher	3	5	11	8	1	28
Parents took part in school decision making process when required	2	6	12	6	2	28

Parents assisted their children with learning during remote teaching

The data illustrated in Table 13 show that 12 (43%) of the teachers agreed that parents never assisted their children with learning during the remote teaching, 10 (36%) of the teachers indicated that parents seldom assisted their children with learning during remote teaching. Five (18%) of the teachers responded that parents sometimes assisted their children with learning during the remote teaching; one (4%) indicated that parents often assisted their children with learning during the remote teaching, and none of the teachers indicated "almost always". It can be deduced from the data that most of the teachers were of the view that parents did not assist their children during the lockdown.

Parents were actively involved in their children's education

On the statement if parents were actively involved in their children's education, eleven (39%) of the teachers indicated that parents were never actively involved in their

children's education, 13 (46%) stated that parents indicated "seldom" while one (4%) said that parents were sometimes actively involved in their children's education. Furthermore, two (7%) of the teachers stated that parents were often involved in their children's education while one (4%) teacher believed that parents were almost always involved. Most teachers generally believed that parents were not actively involved in their children's education during remote teaching.

Parents were eager to obtain information about their children's progress from the teacher

The data in Table 13 further reveals that, only one (4%) of the teachers indicated that parents were almost always eager to obtain information about their children's progress from the teacher, eight (27%) reported often to this statement, 11 (39%) stated "sometimes", five (18%) said "seldom" and three (11%) indicated "never" to the statement. Overall, majority of the teachers, 20 (71%) provided a moderate answer (Almost Always, Often and Sometimes) which suggest an overall willingness of parents to inquire about their children's learning progress.

Parents took part in school decision making process when required

In response to the statement, if parents took part in school decision making process when required, two (7%) of the teachers indicated "never" to this statement, six (21%) said "seldom", 12 (43%) said that parents sometimes took part in school decision making process when required, and six (21%) believed that parents often took part in school decision making process when required while two (27%) of the teachers indicated "almost always" to the statement. From the results one can infer that a moderate number of teachers took part in school decision making process when required.

4.3.6 Views of Chemistry teachers regarding the support from school management toward the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown

Teachers were required to indicate their level of agreement on the statements regarding their views on the support they received from the school management towards the implementation of the new NSSCO Chemistry curriculum during the Covid-19 national lockdown. The results obtained are shown in Table 4.14. A five-point Likert Scale was used, using Strongly Disagree (SD), Disagree (D), Undecided (U), Agree (A), and Strongly Agree (SA).

Table 14

Support from school management toward the implementation of the new Chemistry curriculum

Statements	**SD**	**D**	**U**	**A**	**SA**	**Total**
School management supported teachers with adequate resources required in remote teaching of Chemistry	7	12	2	3	4	28
School management identified staff development needs and addressed them timely	5	9	3	7	4	28
School management virtually monitored remote teaching and learning during the lockdown	4	9	5	7	3	28
School management communicated clearly and in a timely way with the teachers regarding remote teaching	5	14	3	5	1	28
School management promoted teamwork among teachers and encouraged them throughout	1	5	5	13	4	28

School management supported teachers with adequate resources required in remote teaching of Chemistry

The data in Table 14 shows that seven (25%) of the teachers strongly disagreed, while 12 (43%) disagreed with the statement that school management supported teachers with adequate resources required in remote teaching of chemistry. Three (11%) of the teachers agreed with this statement, four (14%) strongly agreed, while two (7%) of the teachers were undecided. The results indicate that overall, most Chemistry teachers, 19 (69%) were of the view that school management did not support teachers with sufficient resources required to conduct remote teaching of Chemistry effectively.

School management identified staff development needs and addressed them timely

The findings in Table 14 further show that five (17%) of the teachers strongly disagreed and nine (32%) disagree with the statement that school management identified staff development needs and addressed them timely. Seven (25%) of the teachers agreed, four (14%) strongly agreed, while three (11%) of the teachers were undecided. From the results, it shows that half of the of the Chemistry teachers, 14 (50%) did not believe that school management identified staff development needs and addressed them in a timely manner, while the other half agreed with the statement.

School management virtually monitored remote teaching and learning during the lockdown

On the statement whether the school management virtually monitored remote teaching and learning during the lockdown, three (11%) of the teachers strongly agreed, while seven (28%) agreed. Nine (32%) of the teachers disagreed with this statement, four 14% strongly disagreed, while five (18%) of the teachers were undecided. The results show

that around 46% of the teachers disagreed with the statement. The broader consensus indicates that school management did not virtually monitor remote teaching during the lockdown.

School management communicated clearly and in a timely way with the teachers regarding remote teaching

The data in Table 14 reveals that most of the teachers, 19 (68%) were of the view that school management did not communicate clearly and in a timely way with the teachers regarding remote teaching. Of the 19 teachers, five (18%) strongly disagreed and 14 (50%) disagreed with the statement. Five (18%) of the teachers agreed, one (4%) strongly agreed, while three (11%) of the teachers were undecided.

School management promoted teamwork among teachers and encouraged them throughout

On the statement whether school management promoted teamwork among teachers and encouraged them throughout, four (14%) of the teachers strongly agree and 13 (46%) agreed with the sentiment. Five (18%) of the teachers disagreed with the statement, one (4%) strongly disagreed, while five (18%) were undecided. More teachers, 60% agreed that school management promoted teamwork among teachers and encouraged teachers throughout.

4.3.7 Views of Chemistry teachers regarding the support from the Regional Office toward the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown

Table 15 gives the responses of the Chemistry teachers on the five statements regarding their views on the support they received from the Regional Office towards the

implementation of the Chemistry curriculum during the Covid-19 national lockdown. Responses include N= Never, S= Seldom, SO = Sometimes, O=Often, AA= Almost Always.

Table 15

Support from the Regional Office toward the implementation of the new curriculum

Statements	**N**	**S**	**SO**	**0**	**AA**	**Total**
The regional office virtually monitored the implementation of the new NSSO Chemistry curriculum effectively during the lockdown	6	10	9	2	1	28
The regional office communicated with the Chemistry teachers constantly to assist them with their needs regarding remote teaching	3	7	16	1	1	28
The regional office linked Chemistry teachers in the region with one another to share ideas on virtual lesson delivery	2	4	15	5	2	28
The regional office provided Chemistry teachers with clear guidance and support regarding remote teaching of Chemistry	3	4	12	6	3	28
The regional office provided helpful guidance on how to support learners' socio emotional wellbeing during lockdown	9	8	6	4	1	28

The Regional Office virtually monitored the implementation of the new NSSCO Chemistry curriculum effectively during the lockdown

Data from Table 15 shows that six (21%) of the teachers responded "Never" to this statement that the regional office virtually monitored the implementation of the Chemistry curriculum during the lockdown. Furthermore, 10 (36%) of the teachers

responded with “Seldom”, nine (32%) of the teachers indicated “Sometimes”, two (7%) stated “Often” and one (4%) indicated “Almost Always”. Most teachers (57%) indicated a general lack on virtual monitoring of the implementation of the curriculum during the lockdown.

The Regional Office communicated with the Chemistry teachers constantly in order to assist them with their needs regarding remote teaching

On the second statement in Table 4.15, one (4%) of the teacher indicated “Almost always” that officials from the regional office communicated with teachers constantly to assist with their needs regarding remote teaching, one (4%) stated “Often”, 16 (57%) stated “Sometimes” to this statement, seven (25%) indicated “Seldom” and three (11%) of the teachers indicated “Never” to having had any such communication with the regional office. A general majority (69%) of the Chemistry teachers stated that they were in communication with the regional office to help them in their needs concerning remote teaching.

The Regional Office linked Chemistry teachers in the region with one another to share ideas on virtual lesson delivery

The responses to the statement if the regional office linked teachers in the region with one another to share ideas on virtual lesson delivery, two (7%) of the teachers said “Never” to this statement, four (14%) indicated “Seldom”, 15 (54%) stated “Sometimes” to this statement, five (18%) said “often” and two (7%) stated “Almost Always”. Majority of the teachers (79%) suggested moderate to extreme connection of teachers in the region to share ideas on virtual lesson delivery.

The Regional Office provided Chemistry teachers with clear guidance and support regarding remote teaching of Chemistry

On whether the regional office provided Chemistry teachers with clear guidance regarding remote teaching and learning, three (11%) of the teachers indicated "almost always" to this statement, six (21%) stated "often", 15 (42%) indicated sometimes, four (14%) responded "seldom" and the last three (11%) of the teachers stated "never". The broader consensus (74%) suggested provision of clear guidance and support from the regional office regarding remote teaching of Chemistry.

The Regional Office provided helpful guidance on how to support learners' socio emotional wellbeing during lockdown

Responding to the statement: "The regional office provided helpful guidance on how to support learners' socio emotional wellbeing during lockdown", nine (32%) of the teachers stated "Never", ten (36%) indicated "Seldom", four (14%) stated "sometimes", four (14%) indicated "Often" and one (4%) said "Almost Always" to the statement. Most of the Chemistry teachers (68%) felt that they were not provided with guidance to support learners' socio emotional wellbeing during the COVID-19 national lockdown.

4.4 Results from the interviews

To obtain in-depth information from the Chemistry teachers regarding the implementation of the new NSSCO Chemistry curriculum during the lockdown, follow up face to face interviews were conducted with 12 purposefully selected Chemistry teachers. The teachers' views were synthesized into themes and sub-themes which are presented in relation to interview questions. The themes and sub-themes are given in Table 16.

Table 16

Research questions and the generated themes

Research Question	**Generated Themes and Sub-themes**
1. What are the challenges experienced by Chemistry teachers in the implementation of the new NSSCO Chemistry curriculum in Otjozondjupa region during the COVID-19 national lockdown?	THEME 1: Challenges Chemistry teachers experienced in implementing the new NSSCO Chemistry curriculum during the COVID-19 national lockdown. *Sub-theme 1.1:* Challenges Chemistry teachers experienced regarding the resources. *Sub-theme 1.2*: Challenges Chemistry teachers experienced regarding the main process of remote teaching and learning. *Sub-theme 1.3:* Challenges Chemistry teachers experienced regarding the assessment of learners. *Sub-theme 1.4:* Other challenges Chemistry teachers experienced.
2. What are the views of Chemistry teachers on the implementation of the new NSSCO Chemistry curriculum in Otjozondjupa region during the COVID-19 national lockdown?	THEME 2: Views of the Chemistry teachers on the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown. *Sub-theme 2.1:* Teachers' views regarding the strategy or instructional tool they used. *Sub-theme* 2.2: Teachers' views regarding conducting practical work in Chemistry during remote teaching. *Sub-theme 2.3:* Teachers' views on whether remote teaching of Chemistry was effective. *Sub-theme 2.4*: Teacher's views on whether they felt adequately equipped and empowered

	to implement Chemistry remotely. *Sub-theme 2.5:* Teachers' views on the support they received from school management and Regional Office.
3. How can the Chemistry teachers effectively implement the new NSSCO Chemistry curriculum in Otjozondjupa region during the COVID-19 national lockdown?	THEME 3: Strategies on how Chemistry teachers could implement the new NSSCO Chemistry curriculum effectively during the COVID-19 national lockdown.

4.4.1 THEME 1: Challenges Chemistry teachers experienced in implementing the new NSSCO Chemistry curriculum during the COVID-19 national lockdown

The aim of the study's first research question was to investigate the challenges Chemistry teachers experienced in implementing the new NSSCO Chemistry curriculum during the national lockdown. Theme one which is generated from research question one, was further broken into four sub-themes regarding the challenges teachers experienced on: resources, the main process of remote teaching and learning, and lastly assessment.

4.4.1.1 Sub-theme 1.1: Challenges Chemistry teachers experienced regarding the resources

Chemistry teachers voiced different resource related challenges they experienced. Most teachers identified a lack of resources, such as a shortage of textbooks, lack of technological tools and poor or a lack of internet access especially for the learners.

These results from the interviews agree with the quantitative data from the questionnaires as 75% of the teachers reported a lack of technological tools and internet connection for the learners. The following excerpts represent the teachers' responses:

Teachers 2: *Even though I have a laptop and a smartphone, as well as access to internet, I could not really make use of them because majority of learners did not have these electronic gadgets or sufficient internet connectivity for us to interact for example via WhatsApp or Zoom.*

Teacher 4: *There was a shortage of Chemistry textbooks as well as poor internet connectivity. The school made an attempt to buy textbooks, but the funds were not enough to buy textbooks for each learner.*

Teacher 12: *Lack of electronic devices such as computers and smartphones from the learners' part, plus majority of them did not have access to internet connection at their homes".*

Teacher 15**:** *The challenge I experienced is that there were little resources available at our school… The textbooks were also few and not enough for every learner...*

Teacher 16: *The challenges I experienced were a lack of modern resources and a lack of internet connectivity for me and for my learners, especially here in the rural areas.*

Teacher 20: *It was very difficult to cope with the demands of teaching and learning during the lockdown due to a lack of resources ... Our school lacks necessities such as science equipment and an equipped science laboratory. ...majority of the learners did not have the needed devices and internet access for me to communicate with them.*

Teacher 22: *I experienced lack of resources amongst other things, particularly the teaching and learning aids. Lack of textbooks has always been an issue too… also a lack of IT resources, as some learners did not have smartphones or laptops. Few had the technological gadgets but didn't have data or internet to access online information.*

Teacher 29**:** *I did not have the material for teaching Chemistry on a distance mode. Most of my learners also were not in possession of smartphones and tablets for me to send them information and videos via WhatsApp.*

From experience, one is aware that meaningful teaching cannot take place without the necessary tools and resources as a lack of resources limits the teaching process. Singh-Pillay (2012) emphasizes that implementation of a new curriculum without adequate resources puts strain and stress on teachers which hinders effective implementation. Thus, when teachers are provided with the necessary teaching materials, it allows them to put all their efforts on the teaching process rather than on trying to track down resources they do not have.

4.4.1.2 Sub-theme 1.2: Challenges Chemistry teachers experienced with regard to the main process of remote teaching and learning

The findings illustrate the main challenges teachers experienced regarding the process of remote teaching and learning of Chemistry during the lockdown which were: teachers' lack of skills on how to go about remote teaching, teachers' inability to cover all the work, and teachers' inability to reach and monitor all the learners. Other challenges included lack of skills among teachers on the use of technological tools, and lack of

interest and commitment from the learners, and lastly, learners' inability to study and understand the subject content on their own. These results coincide with the data from the questionnaires, whereby 72% of the teachers believed that during remote teaching, learners struggled to study and master the Chemistry content. This is how the teachers responded:

Teacher 4: *Well, most of the learners did not attempt to do the activities they were asked to do. Some informed me that they could not understand the notes by reading them on their own without me giving them explanations in class. The fact that I could not do experiments and demonstrations to help explain some of the concepts in Chemistry was also a challenge.*

Teacher 6: *It was difficult for me to design e-learning materials for my learners because I did not have any prior knowledge to use technology in my teaching. Staying in contact with my learners was another difficulty I experienced during remote teaching. Also, there many learners lacked motivation which hindered remote teaching.*

Teacher 8: *... low participation of learners in online classes. I also found it difficult to monitor the learners' progress. In addition, some learners could not cope to learn Chemistry on their own. Another thing is, I also struggled when it came to utilizing technology equipment in my teaching because I was not experienced or trained to use them.*

Teacher 12: *I encountered challenges such as difficulty communicating with my learners during the distance learning process. It was also difficult to explain the content to the learners via booklets, without us being face to face. On top of that,*

learners were very reluctant to study the notes I provided them with, and it was also very difficult to monitor them during the learning process. The other problem is that most of the learners were not motivated to learn at home.

Teacher 13: *Some learners did not show interest to continue learning during the lockdown. Therefore, I could not cover most of the work I planned to cover during remote teaching.*

Teacher 16: *I was unable to reach all the learners during the lockdown… My ability to teach Chemistry virtually effectively was limited due to a lack of knowledge to use the technological devices to design and offer effective lessons to my learners during the lockdown.*

Teacher 29: *Only few learners were able to attend online classes, and some seemed to be anxious towards the new approach of teaching and learning. Myself, I was not used to the new system of teaching and so I needed some preparation in form of training, even virtually.*

According to Yusuf and Ahmad (2020), teachers require more support and training especially in technology, particularly during the COVID-19 pandemic. This could mitigate the challenges they experience and could enable them to feel more confident in their remote instruction, which will allow them to provide quality and effective teaching, and increase the support and the level of learning to students.

4.4.1.3 Sub-theme 1.3: Challenges Chemistry teachers experienced regarding to the assessment of learners

Most of the Chemistry teachers described assessing learners during remote teaching as the biggest challenge they faced. The following challenges were stated: some teachers lacked knowledge on setting online assessment activities, learners did not submit the tasks on time, and some did not submit them at all. Moreover, most learners did not grasp the content on their own which resulted in poor performance in their learning activities. Furthermore, some teachers feared that some learners did not answer the questions on assessment on their own. Learners had to be re-assessed upon returning for face-to-face classes. The following are the teachers' responses.

Teacher 2: *Majority of learners did not answer the questions in the tasks, few attempted to answer some questions but could not get most of them correct. Upon questioning these learners when the school re-opened most of them indicated that they could not understand the notes on their own without the teacher's explanations.*

Teacher 4: *Some learners did not come to collect the assessment activities for completion. Some that collected did not hand in the activities and some activities handed in were not completed in full. I also felt like I did not get the true reflection of the learners' progress regarding their performance in the assessment activities, as some learners could have asked someone else to answer the questions on their behalf. To get marks for the learners, I gave them different activities for assessment upon them returning to school.*

Teacher 8: *To me doing assessment during remote teaching was one of the biggest challenges I experienced, because majority of learners did not complete the tasks at all. It was also difficult to monitor the few learners that did the work if they were really the one getting the answers to the questions, or someone else did the activities for them.*

Teacher 10: *Most of the learners did not submit their work on time and there were some learners who did not returned the activities to me at all at all. Learners' progress was also difficult to monitor since they were doing all activities at home.*

Teacher 20**:** *The challenge I encountered was learners not returning the completed activities or tasks back to me. Few that did, some of the questions were not answered. I also could not give feedback as the communication between us was poor.*

Teacher 22: *Some learners struggled to understand the content on their own and this hindered their progress in answering the questions in the assessment activities. Some learners seemed to have shared the answers with each other. The other challenge I faced was that not all learners submitted their work.*

Teacher 29: *It was difficult to get the completed assessment tasks back from the learners, despite having given them a due date. Cheating was also detected as some learners had the same answers throughout, both correct and wrong ones. I reassessed all the learners when normal classes started.*

From the interview's excerpts, it is evident that most Chemistry teachers found assessing learners during the lockdown to be a daunting task. However, the importance of assessment is emphasized by Kartimi et al. (2021) who explained that the learning and

assessment processes are inseparable. Proper assessment of learners is required in online teaching to classify and grade students, provide feedback, and allow teachers to structure their instruction accordingly.

4.4.1.4 Other challenges Chemistry teachers experienced

When the teachers were asked to share other challenges they experienced, they had this to say:

Teacher 4**:** *There was a lack of communication between myself as a teacher and the parents.*

Teacher 6: *Unequal opportunity in education for learners as learners from disadvantaged background didn't have digital gadgets or suitable learning environment at home. I also did not have effective strategies in delivering remote teaching successfully.*

Teacher 10: *Parental involvement in their children's education was very poor, this has been the case even before the lockdown. A lot of parents didn't seem to encourage their children to continue learning while at home either and this also hinders the learning process.*

Teacher 13: There didn't seem to be supervision of some of the learners to continue learning at home. It is as if they were on holiday. Some learners also informed me when they got back to school that they did not have quiet places to study at home because they are a lot in their homes.

Teacher 15: *Limited budget at our school, hence the needed materials could not be purchased. There has also been a limited focus on the use of technology before*

the lockdown and so it was difficult for some of us to quickly adapt to using technology in remote teaching.

Teacher 16: *Since there I was no longer physically interacting with my learners, the role of me as a teacher to also instil character education in my learners could not be fulfilled. It was also difficult to keep up communication with some parents because they did not show much interest.*

Teacher 22: Some parents could not assist their learners at home as they didn't have even the basic knowledge on the subject of Chemistry.

Teacher 29: *There was a lack of support from private companies in the community or constituency to assist the school in terms of technology devices sponsorship, even though we wrote to these companies for sponsorships.*

4.4.2 THEME 2: Views of Chemistry teachers on the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown

Theme two is generated from research question two and was broken down into sub-themes and teachers were asked to express their views regarding the following: the strategy or instructional tool they used, covering practical work during remote teaching, effectiveness of the implementation of Chemistry during the lockdown, if they felt equipped and empowered to implement Chemistry remotely and lastly, the support they received.

4.4.2.1 Sub-theme 2.1: Teachers' views regarding the strategies or instructional tools they used

The teachers' responses are illustrated in the excerpts below:

Teacher 2: *I initially tried to use Zoom meeting platform but only around 30% of my learners took part in it. So, I decided to compile booklets then I called parents for collection. Then I used WhatsApp platform to share self-recorded videos giving explanation of the content. Almost all the learners got the booklets but around half of the learners did not have internet/ smartphones for WhatsApp.*

Teacher 4: *The only strategy I had as an option was to compile booklets containing notes and activities which learners had to come and collect. ...I made sure that social distancing was observed. In the end I felt that the strategy I used was not really useful as a lot of learners didn't seem to have read the booklet.*

Teacher 6: *Booklets were handed out and some explanations were given via the class WhatsApp groups for the parents. Almost every learner got the booklet but not all learners had could access information through WhatsApp.*

Teacher 8: *The instructional tool I used was WhatsApp groups where I shared the learning materials, but not everybody had access to the information.*

Teacher 13: *I found different ways to convey instructions to the learners. I used handouts as well as self-recorded videos where I gave explanations on some of the notes in the handouts, especially on the abstract concept of Chemistry.*

Teacher 20: *"I used the method of handing out hard copies like booklets to the learners".*

Teacher 22: *"I prepared noted for my learners, with clear explanations. I also shared information with them via WhatsApp application, but a lot of learners did not have the devices to access WhatsApp. The notes were particularly easy to use as learners came to collect them and kept them in their possessions.*

From the interview excerpts, one can deduce that the instructional tool used was primarily provision of booklets to learners. The other tool used was WhatsApp, which teachers used to communicate with their learners and share information, however most learners could not access WhatsApp due to the lack of devices and internet.

4.4.2.2 Sub-theme 2.2: Teachers' views regarding conducting practical work in Chemistry during remote teaching

On the aspects of conducting practical work in Chemistry while implementing remote teaching, teachers gave the following responses:

Teacher 2: I could not conduct practical work or experiments at all during remote teaching. Where I had the resources, I recorded short videos of myself doing some demonstration which I posted on the class WhatsApp platform. I also indicated to the learners in the booklets for them to search for videos demonstrating the experiments on YouTube, but only few learners had the mean to do that.

Teacher 4: *I tried explained the practical work with usage of diagrams and notes which I send out to my learners. Added to that, I sent information to the learners on how to conduct some simple experiments using the reagents available at home. I also provided them with notes on practical works and the examples of materials at home that the learners could utilize at home.*

Teacher 6: I normally borrow the apparatus from a school in the same circuit but that was not possible during the lockdown and so I did not do any practical remotely.

Teacher 8**:** *It was difficult to go about this aspect of Chemistry when learners are not present in the classroom. What I did was that I left out the practical parts of the topics and only came to cover them after face-to-face sessions resumed.*

Teacher 12**:** *To cover the practical parts of the subject during remote teaching, I prepared demonstrations through diagrams and shared them on the platforms as I didn't have the resources to do the experiments and video record myself.*

Teacher 13: *For the experiment or practical part of the subjects, it was very difficult to cover it. What I did is that with the help of my HOD, I recorded videos of myself doing experiments and posted them on the class WhatsApp group. But I told learners to make use of internet to watch demonstration of practical work on specific topics. This was another challenge again as only few learners had internet and the gadgets.*

Teacher 20: *Doing practical work was impossible because we could not meet face to face. Our science laboratory is not even equipped for me to even do and use virtual laboratories. I put my thrust on using pictures, sketches and drawing with explanations, which I sent to the learners.*

The responses illustrate that in most cases, no practical work was carried out during remote teaching. In some cases, the teachers took videos of themselves conducting practical work and share them with the learners via WhatsApp. In a few cases learners were provided with instructions by teachers to carry out practical work that were safe to be carried out at home, for example using home mixtures or reagents. Some teachers asked the learners to search and watch the videos demonstrating the concepts in the content on internet or YouTube. According to Mrani et al. (2020) the implementation of

practical work in Chemistry during online teaching must be adjusted to accommodate learning that no longer takes place in laboratories. In their study, Kartimi et al. (2021) revealed that during remote teaching, teachers were implementing lab work using virtual laboratories, animated videos, and video tutorials.

4.4.2.3 Sub-theme 2.3: Teachers' views on whether remote teaching of Chemistry was effective

On the questions whether remote teaching of Chemistry was effective, teachers gave the following responses:

Teacher 2: *I don't think remote teaching was effective because there are a lot of learners that did not have the resources required to keep engaging in the process of learning.*

Teacher 6: *In my view it was ineffective because according to my observation very little teaching and learning took place. I think only those learners who could read and study the notes on their own learned something. But then, the majority of learners did not seem to have read the notes at all.*

Teacher 8: *It was not really effective, because not all learners were accessible and not all learners had access to internet or had data to get the information. Also, there was a lack of collaboration between the teacher and the learners which hindered the teaching and learning.*

Teacher 10: *To me the implementation of the new NSSCO Chemistry curriculum was not effective because it only benefitted some learners. Most of the learners did not have access to internet and electronic devices. Some learners did not participate*

during remote teaching and some who were willing to learn did not have proper learning materials.

Teacher 12: *I would say that it was not really effective. It worked for the few learners who could access the information teachers provided to them for example via WhatsApp. As for the rest of the learners who didn't have computers or smartphones and access to internet, they were left out and this stalled the teaching and learning process.*

Teacher 13: *For the learners who continued to learn on their own, had electronic gadgets with internet connectivity and parents to assist them, it was in some ways effective for them. For the rest of the learners who did not have the things that I just mentioned, it was not effective. So, in some cases I think it was effective, but in most cases, it was not.*

Teacher 20: *I tried my best... but proper teaching and successful learning was difficult to reach.*

Teacher 22: *No, it was not effective. There was a lack of resources and finances at our school needed to effectively carry out proper planning. Also, there was a lack of guidance on how we teachers should go about remote teaching.*

Teacher 29: *To me I would say it was roughly 50% effective. Some learners were motivated, showed interest, attended online classes, and carried out the work given to them and so in the end learning for these learners took place. But for others, nothing much happened.*

From the responses of the Chemistry teachers, one can conclude that most teachers found the teaching of Chemistry through remote teaching to be ineffective, and the

prime reason for this is that not all learners had resources such as the electronic gadgets needed to communicate with teachers and receive the learning contents. Only a few participants found teaching Chemistry remotely to be in some ways effective.

4.4.2.4 Sub-theme 2.4: Teacher's views on whether they felt adequately equipped and empowered to implement Chemistry remotely

Teachers were asked if they felt adequately equipped and empowered to teach Chemistry remotely. Few teachers mentioned that they had some skills on teaching using technology. However, more teachers indicated that they were not well equipped in terms of the technological skills to conduct remote teaching. They felt that they needed training on the new mode of teaching. From the quantitative data, 79% of the teachers reported that they felt insecure to teach Chemistry remotely, which agrees with the data from the interviews. They further mentioned that without a provision of adequate resources to provide to learners, they would not be feel adequately equipped. The following are the teachers' responses:

Teacher 2: *No, I did not feel empowered nor equipped to teach Chemistry via remote teaching. I had some skills on the use technology in teaching, but I felt like I needed a bit of training on how to go about the whole process. I also think that if I had the resources I needed, that would have boosted my confidence.*

Teacher 4: *I felt anxious plus I had some fear in me about remote teaching. I believed that if only we had resources and the skills to integrate technology in our teaching before the lockdown, then some of us wouldn't have felt powerless.*

Teacher 8: *Initially, I didn't feel equipped or empowered because I didn't have enough resources or tools and skills to ensure effective remote teaching. But I tried to get*

some information from internet regarding remote teaching. I wish the ministry had provided us with some training even online, but I do understand because the situation happened very fast.

Teacher 16: *I was not prepared for this and so I felt unsure about my abilities. The lack of resources made things worse for me.*

Teacher 20: *In some ways I felt equipped and empowered as I had some considerable number of skills on how integrate technology in teaching and learning.*

Teacher 29: *I was not equipped or prepared for this at all, and I think the ministry could have done better than just instructing us to implement remote teaching just like without any training, even via online. I feel most of us needed some a bit of training on online teaching.*

According to Kartimi et al. (2021) during the COVID-19 pandemic teachers had to suddenly conduct online learning without receiving appropriate training. This situation forced many teachers to improvise their teaching practices which in some cases did not yield results.

4.4.2.5 Sub-theme 2.5: Teachers' views on the support they received from school management and Regional Office

On the question regarding the support teachers received, they answered as follow:

Teacher 2: *The management supported me by giving me ideas on how better I could support and keep my learners engaged in learning from home. It also ensured that copies of booklets were made. From the regional office, I was provided with*

policies, encouragement, and motivation to face the situation. I feel that the regional office was supposed to do more in assisting and guiding us.

Teacher 4: *At school we had departmental meetings via Zoom every week where we shared the challenges experience and together suggested strategies to overcome them. The regional office linked me up with some colleagues in the region. Through that we were able to share ideas on how to develop learning materials. My advisory teacher also provided me with circulars about implementing remote teaching.*

Teacher 12: *The school management offered me brief training via our departmental WhatsApp group platform on how to create platforms for learning and teaching, so I am able to interact with my learners. The management also shared with me information on how to obtain activities from NIED website. In addition, my head of department collaboratively worked with me and other teachers on how to better approach remote teaching. From the side of the regional office, I didn't get much support except for the directives that were given to me.*

Teacher 22: *The support I received from the school management was through making copies of notes as textbooks were not adequate. My Head of department encouraged me continuously and kept checking in with me via the WhatsApp group to share information, offer support and assistance when I needed it. This also minimized social isolation. From the regional office, they only supported me by sharing the circulars regarding remote teaching.*

One of the constructs of Rogan and Grayson's (2003) theory, emphasizes support from outside agencies, such as the regional office to support innovation. Chemistry teachers indicated during interviews that they received some support from school management and regional office. School management primarily helped with guidance on remote learning and the provision of booklets for remote learning. The regional office helped by providing guiding circulars and encouragement on how to conduct remote learning. However, teachers felt that the support they received from the regional office was not sufficient. The quantitative data from the questionnaires contradicts these results as it reveals that most teachers (74%) indicated that they were provided with clear guidance and support from the regional office during the lockdown. Ngara et al. (2013) noted that educators require guidance and support, especially when implementing a new programme. This would enable them to cope with implementation difficulties, thus enhancing the teaching process.

4.4.3 THEME 3: Strategies on how Chemistry teachers could improve the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown

Lastly, Chemistry teachers were asked to recommend strategies that could improve implementation of the Chemistry curriculum during the remote teaching and learning process. The following are the teachers' responses:

Teacher 2: *The Ministry should compile teaching and learning materials to be distributed to all teachers and learners. Such materials can should also be available on a learning platform, so teachers are able to access it anytime. It*

should also provide online workshops for teachers on how to conduct online teaching on assessing learners during remote teaching.

Teacher 4*: Increase support for teachers from school management and the education ministry. Government should increase internet penetration in schools and in communities. The schools should be equipped with adequate resources to conduct remote teaching effectively, this also include a textbook for each learner.*

Teacher 6: *All schools need to have adequate resources to their exposures. Increase government support in training teachers and providing the necessary resources to enable efficient remote teaching. Most importantly, the use of IT in teaching Chemistry should be emphasized and so teachers should be trained on it. Teachers must be provided with guidelines regarding practical work during remote teaching.*

Teacher 8: *Parents should ensure that there is a conducive environment for children to learn at home. Government should help less privileged learners with gadgets for remote learning. Each learner should have a textbook to help them learn.*

Teacher 10: Increased regional support for teachers. Provision of remote learning devices to learners. It is also important to provide teachers with clear remote learning guidelines, especially on the practical parts of the subject and also on assessing leaners remotely.

Teacher 12: *The ministry should ensure that the teachers have the necessary tools and skills to practice remote teaching and that they have sufficient knowledge to use technological tools and administer classes online or remotely. The teacher training institution should also train teachers during their studies on how to integrate the use of IT in their lessons.*

Teacher 13*: Chemistry teachers should be provided with training on how to use information and technology tools more in their teaching and also on how to assess learners' progress during remote learning. The ministry should do more to train teachers in remote learning and provide the necessary resources.*

Teacher 15**:** *The ministry should compile teaching materials and assessment activities for remote teaching that should be provided to all Chemistry teachers so that quality work is not compromised. The ministry should also train teachers on remote teaching as majority of teachers lack the necessary skills on it and this added to teachers' stress. Schools should be equipped with enough resources as well.*

Teacher 16: *Firstly, the ministry should ensure that schools are in possession of the resources needed. Then, teachers and school management and advisory teachers in different regions must collaborate and share ideas on how to improve the process and outcomes of remote learning.*

Teacher 20: *Each should be provided with enough textbooks for learners and all the other needed resources. Teachers require more training on how to assess students during online teaching. The ministry should enforce compulsory training for teachers on how to carry out remote learning as well as the use of information and technology tools in teaching.*

Teacher 22*: Teachers must be given clear guidelines on how to go about online teaching and the ways to effectively carryout out Chemistry classes, especially on how to cover the parts of experiments in Chemistry. The education officers should set up assessment tasks and share them with all Chemistry teachers in the region.*

Teacher 29**:** *Parents must be actively involved by continuously encouraging their children to continue learning, keep in touch with teachers and agree on ways which they can help improve the learning experience of the learners.*

Most Chemistry teachers recommended increased teacher training on remote teaching, particularly on the use of technological tools in teaching. They also indicated that Chemistry teachers should be guided on conducting practical work and on how to assess learners during remote teaching. Teachers also suggested that the MoEAC provide adequate resources and textbooks for the learners. For quality control purpose, the MoEAC should compile teaching materials and activities for assessment for Chemistry and send them to all teachers to be used during remote teaching. Lastly, it was suggested that there needs to be increased parental support for their children's learning activities, and greater collaboration between Chemistry teachers to share ideas on how to improve the quality of remote teaching.

4.5 Summary of the chapter

The chapter presented and analysed the results collected from the questionnaires and interviews that provided individual experiences of the participants. The results from the questionnaire were presented using numerical frequency tables and analysis was done using descriptive statistics. Descriptive statistics helped illuminate prominent views based on the number of respondents who agreed with a statement, resulting in the statement either being a persistent truth or a lukewarm one; these persisting truths were then supported by the literature review, wherever there was an agreement in view between primary data and secondary data.

Data from interviews was analysed using thematic analysis. It can be concluded from the interview results that most participants experienced similar challenges and shared similar sentiments, for example the challenges most of the Chemistry teachers experienced were a lack of resources, particularly on the side of the learners, difficulty staying in contact with learners, inability to do practical work, and difficulty assessing learners during remote teaching. The next chapter will present the discussion of the findings of the study.

CHAPTER 5: DISCUSSIONS AND INTERPRETATION OF THE FINDINGS

5.1 Introduction

This chapter discusses the findings of the study that investigated the challenges Chemistry teaches faced in the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown. The findings are discussed according to the themes and sub-themes. An introductory discussion is initially presented to articulate the link between the findings and the theoretical framework.

5.2 Link between the findings and the theoretical framework

The study adopted the theory of curriculum implementation by Rogan and Grayson (2003) to frame and guide the research. The theory was designed to help guide teachers in being cognizant in their abilities to implement a curriculum and identify factors that impact how they implement it.

The findings indicate that the teachers in the study experienced numerous challenges while implementing the new Chemistry curriculum during the lockdown caused by COVID-19, as they had to quickly shift to a new pedagogic mode of teaching. The challenges teachers experienced include: inadequate resources to teach Chemistry remotely such as textbooks, apparatus and chemicals, technological tools, internet access and technological skills. Moreover, teachers faced challenges such as: lack of knowledge to navigate remote teaching, poor commitment from the learners, inability to cover practical work, difficulty in conducting assessment, poor parental support and engagement, and insufficient support from the regional office (education department).

The findings highlight the relationship between the main constructs and the sub-constructs of Rogan and Grayson's (2003) theory. They suggest in one of the construct "capacity to support innovation" that for a curriculum to be implemented effectively, schools need to be equipped with adequate resources in terms of: a) physical resources (textbooks and teaching materials); b) teacher factors (teachers' training, teachers' qualification and teachers' confidence); c) learner factors (their commitment and proficiency in learning), and d) school ethos and management (commitment by everyone to implement the curriculum successfully). In the second construct "profile of implementation", Rogan and Grayson (2003) view science practical work and assessment compulsory in the implementation of science subjects. The implementation of Chemistry requires teachers to conduct practical work, but this was a challenge during the lockdown as the laboratories could not be accessed and some schools did not have science laboratories at all. Lastly, in the construct "support from outside agency", Rogan and Grayson (2003) emphasize that provision of resources, in-service teacher training, teacher support, and curriculum implementation monitoring by advisory teachers education department personnel are all critical to successful curriculum implementation.

The theory of Rogan and Grayson's (2003) was chosen to guide the study because each of its constructs aids in understanding, analysing, and expressing the extent to which the ideals of the Chemistry curriculum are realized into context during remote.

5.3 Discussion of the findings

The aim of the study was to investigate the challenges Chemistry teachers experienced when implementing the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown.

The study followed an explanatory sequential mixed methods approach and targeted all (32) Grade 10 and 11 Chemistry teachers in Otjozondjupa Region. The research instruments were closed-ended questionnaires and interview guides. The quantitative data collected were presented in tables while the qualitative data were presented according to the themes and sub-themes generated from the study research questions. The following is the discussion of the findings under the designated themes and sub-themes:

5.3.1 THEME 1: Challenges Chemistry teachers experienced in implementing the new NSSCO Chemistry curriculum during the COVID-19 national lockdown.

The first theme which is about the challenges that Chemistry teachers experienced was divided into four sub-themes. These sub-themes discuss specific challenges regarding resources, the main teaching and learning process, assessment, and other challenges experienced.

5.3.1.1 Sub-theme 1.1: Challenges Chemistry teachers experienced regarding the resources.

Chemistry teachers faced significant difficulties such as a shortage of textbooks and teaching materials, and technological resources needed for remote teaching to

materialise. Most teachers stated that it was difficult to deliver lessons during the lockdown because most learners did not have ICT e-learning resources such as smartphones, tablets, or computers to enable them to communicate with the teachers and receive information regarding the subject.

According to Rogan and Grayson (2003), limited resources such as textbooks and science laboratories hamper curriculum implementation Thus, the provision of adequate resources such as good internet infrastructure and accessibility to computer hardware for learners results in effective online learning (Xie et al., 2020). Unfortunately, in Otjozondjupa Region some teachers and most learners did not have the necessary resources which negatively affected their distance teaching and learning process of Chemistry during the lockdown. It is evident from the results, that the lack of resources during remote teaching had a negative impact on the implementation of the Chemistry curriculum.

Van der Nest (2012) pointed out that having adequate resources such as textbooks and laboratories is a vital factor in implementing a curriculum efficiently and a shortage of these compromises the implementation of a curriculum. Moreover, Fullan (2007) warned that implementing a new curriculum places additional demands on school resources, and a lack of resources limits the teacher's ability to successfully implement the curriculum. Besides, a transition from the traditional classroom to a virtual classroom supported by sophisticated communication technology, such as in the case of COVID-19 lockdown, presented a new challenge for teachers and learners because teachers had to swiftly implement a new pedagogical approach (Wisanti et al., 2021). Additionally, Alghamdi (2021) emphasises that a deficiency in technological resources

has negative implications on the teaching and learning process during the COVID-19 pandemic since there is a ban on face to face classes. Ginsburg et al. (2017) observed a lack of instructional materials that teachers in low- and middle-income countries faced when implementing curriculum. Considering that the transition from face-to-face teaching to remote teaching happened unexpectedly, teachers and learners experienced various challenges since they were not prepared for this transition. In this case, the lack of resources led to ineffective implementation of the Chemistry curriculum during the COVID-19 lockdown.

5.3.1.2 Sub-theme 1.2: Challenges Chemistry teachers experienced with regard to the main process of remote teaching and learning.

The analysis of the data reveals that even if e-learning hardware and internet were available, most Chemistry teachers lacked the capacity for using technological tools required to implement the curriculum via distance mode successfully. These results are in line with the findings of Talidong and Toquero (2020) who determined that most teachers in Philippines were not skilled enough to teach via e-learning during the COVID-19 lockdown. Moreover, teachers in Otjozondjupa noted that the few learners that had communication tools lacked the technological skills to operate these tools for learning purposes. This result is in agreement with Okebukola et al. (2020) who reported that in Senegal, both Chemistry teachers and learners faced the challenge of a low-level preparedness when changing from traditional lesson delivery to online teaching. Likewise, Wisanti et al. (2021), found that both teachers and learners faced a major problem in operating technology applications. It is worth noting that having the necessary skills for using technology in the classroom is a crucial aspect that influences

innovation and enables teachers to design engaging and effective lessons (Kartimi et al., 2021).

Valverde-Berrocoso et al. (2020) and Allen et al. (2020) alluded that schools and learners be prepared with digital competencies for the implementation of online learning because it requires the use of supporting devices such as computers, laptops, and smart phones. They also stated that both teachers and learners should first acquire technological skills in order to use these tools, as this greatly influences the success of implementing online learning. Most teachers experienced challenges because they were not prepared for the abrupt shift to the use of technology in teaching, as most did not integrate it in their teaching before the lockdown. These challenges resulted in teachers feeling overwhelmed and developing negative perceptions on implementing Chemistry virtually, leading to possible negative implementation experiences.

Difficulty explaining complex concepts in Chemistry and the inability to do practical work was another challenge that Chemistry teachers experienced during remote teaching. Furthermore, teachers reported difficulty reaching learners during the lockdown; hence they were unable to teach all the planned content. Another factor that teachers revealed was a lack of learner commitment as well as incapacity among some, to comprehend the Chemistry content on their own.

Chemistry teachers also acknowledged other non-technological problems that they experienced which included, a lack of motivation and unruliness among some learners during remote teaching. Some participant teachers felt that most of the learners demonstrated poor commitment to learning, plus some learners did not have the

cognitive abilities to learn remotely. Teachers further indicated that the learners that failed to grasp the Chemistry content on their own, struggled to complete the assessment activities which resulted in them lagging behind in learning. Dhawan (2020) indicated that to increase learner engagement in remote learning, teachers should engage and provide personal attention to the learners to help them adapt to new learning approaches. They further stated that teachers should improve the quality of the content so that it is more engaging to learners.

The literature suggests that an informal environment in remote learning hinders learners' level of motivation, and a lack of contribution from other learners reduces their insights (Levine, 2005). Piller (2015) noted that, keeping learners motivated and engaged throughout their study during distance learning is a challenge. Equally, Hung et al. (2010) stress that learner motivation is an important aspect in virtual learning, therefore teachers should keep learners motivated to continue learning. Learners could be motivated by having the teacher do the following: communicating with every learner, greeting learners, posting simple video of 'welcome to class', showing them appreciation, praising them and giving them positive feedback (Wisanti et al., 2021). On this note, participants felt that a lack of motivation amongst the learners affected the teachers' abilities to implement the Chemistry curriculum successfully because it meant lower study effort from the learners.

5.3.1.3 Sub-theme 1.3: Challenges Chemistry teachers experienced regarding the assessment of learners.

Student assessment provides an opportunity for teachers to gather information about the students' progress and give them feedback regarding their attainment of the competencies (Rashid & Jaidin, 2014). Learning assessment was still necessary during COVID-19 outbreak to provide teachers with information on how well learners were absorbing the learning materials (Handoyo et al., 2021). Moreover, learner evaluation was important in determining how effectively the teacher carried out the teaching process (Handoyo et al., 2021). As a result, educators were required to adopt new approaches to educational assessment in order to measure the quality of learning during distance learning (Elzainy et al., 2020).

According to the study findings, administering assessment to learners during the lockdown was challenging for Chemistry teachers. The data indicated that most teachers did not have a clear direction on how to conduct assessment remotely. Teachers blamed this on the education department as it failed to provide them with clear guidance on how exactly they were supposed to conduct assessment in an absence of face-to-face sessions. In Canada, teachers felt challenged in conducting assessments during the lockdown due to a lack of training and prior exposure, so they lacked the skills and time to implement more authentic assessment (DeCoito & Estaiteyeh, 2022). According to Khlaisang and Koraneekij (2019), assessment techniques in online teaching can be carried out using applications such as Google Classroom media, email-based assignments, WhatsApp and Zoom. Moreover, some Chemistry teachers complained that they detected cheating among some learners. Handoyo et al. (2021) shared similar

views that the process of students answering questions at home presents the possibility of them being dishonest.

Another challenge that Chemistry teachers faced was a lack of accountability among some learners, as such learners were not submitting their tasks by the due dates and some failed to submit their work at all. According to Sharadgah and Sadi (2020) and Huber and Helm (2020), due to the low level of learning among the learners, the assessment conducted during the COVID-19 pandemic did not provide valid data. Sadeghi (2019) claims that the risk of students becoming distracted and losing track of due dates is high during distance learning, hence students must remain motivated and focused if they are to continue learning. Learners not submitting the assessment tasks made it difficult for the teacher to measure their learning progress and to check if they needed to change their own teaching strategies or not. The challenges teachers experienced with assessment caused them to conclude that the assessment process was unsuccessful. In most cases teachers had to create new assessment activities and re-assessed learners when normal classes resumed. Before re-assessing learners, some teachers had to first revise the content covered during the lockdown to cover any learning gap or losses.

5.3.1.4 Sub-theme 1.4: Other challenges Chemistry teachers experienced.

Teachers encountered other challenges in the implementation of the new Chemistry curriculum during remote teaching. Teachers reported a lack of communication between themselves and the parents as well as poor parental involvement in their children's education during remote teaching. They further highlighted that there was a greater

unequal opportunity in education for learners. This suggests that learners from disadvantaged backgrounds faced more hardships, plus they lacked appropriate technology to communicate and receive educational information or support from teachers. Additionally, teachers claimed that such learners were unlikely to have a conducive learning environment at home to continue learning properly. Teachers further mentioned a lack of support from the private sector, despite making requests for any types of assistance or donations particularly in terms of resources.

5.3.2 THEME 2: Views of the Chemistry teachers on the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown.

The views of Chemistry teachers on the implementation of the Chemistry curriculum were grouped into three sub-themes which are given in the next discussion.

5.3.2.1 Sub-theme 2.1: Teachers' views regarding the strategy or instructional tool they used.

Regarding strategies or instructional tools to conduct remote teaching, the data reveals that most teachers compiled booklets containing noted and activities, which were given to the learners to read and study at home. In some cases, this was compensated by teachers providing further explanations on the content via the WhatsApp platform. The booklet was the most common used tool while WhatsApp was regarded as the second most used tool which teachers employed to share the subject content and other information with the learners. However, there was a shortcoming with using WhatsApp because not all learners had the electronic gadgets to access it, and this was a hindrance in the process of teaching and learning of Chemistry during the lockdown. In addition,

for learners to receive information through the WhatsApp application, not only were they supposed to be in possession of smartphones, tablets, or computers, they were also required to have data or internet connectivity, which most learners did not have.

According to Astini (2020) and Kartimi et al. (2021) Google Classroom, Zoom, and WhatsApp are all useful applications for online teaching and learning. Although the WhatsApp app is thought to be easier to use than Zoom and Google Classroom, all of these platforms require an internet connection to enable effective online teaching and learning processes (Prabawati, 2021). Shidiq et al. (2021) noted that most teachers in West Java Province in Indonesia, used Google classroom to conduct distance learning while some teachers used the Zoom meeting platform. They further suggested that teachers could also use WhatsApp, Quizizz, Cisco and YouTube for online learning. It is important to stress that in order to effectively conduct online learning, teachers must have good technological pedagogical knowledge (Kartimi et al., 2021).

5.3.2.2 Sub-theme 2.2: Teachers' views regarding conducting practical work in Chemistry during remote teaching.

From experience, it is known that the subject of Chemistry cannot be separated from practical work. As Schwichow et al. (2016) point out, practical work is a vital part of teaching and learning Chemistry, as it provides benefits such as developing laboratory skills and scientific knowledge, as well as assisting students in better understanding science concepts and theories. Additionally, practical work is one of the factors which motivates learners to learn science, increase their scientific knowledge, and broadens their perspectives (Bergin, 1999; Hodson, 1990). According to the participants, it was

difficult to cover the practical part of Chemistry during the lockdown due to the schools being closed which meant that the science laboratories were out of reach. In most cases the practical work was not done until when learners returned to school. However, some teachers decided to improvise by recording short videos of themselves doing some demonstrations and these videos were sent to the learners who had WhatsApp. Other teachers instructed learners to watch videos on YouTube, showing demonstrations or experiments on relevant topics to complement the theoretical part of the subject. These results agree with Shidiq et al. (2021) who found that during remote teaching, most Chemistry teachers in Indonesia tried to organize practical work for the learners but they did not succeed. Others, tried to utilize lab-work multimedia, but that did not make learners master the processes skills.

The finding further indicates that some Chemistry teachers instructed learners to do some simple practical work on their own using the reagents available at home. All these efforts were done to compensate on the absent of practical work in a science laboratory. Regrettably, teachers reported that not all learners benefited from these attempts as some did not have the resources required to access them, such as internet connectivity and smartphones or computers. From the data obtained, one can conclude that the problem of implementing practical work during the lockdown hindered effective teaching and learning of Chemistry as the practical part of the subject was poorly accommodated. Wisanti et al. (2021) stressed that most teachers had difficulties implementing practical work in Chemistry as well as explaining concepts to support students' mastery of abstract concepts during remote teaching. Furthermore, in their study it was found that some teachers replaced practical work with different tasks, while others attempted to use

virtual laboratories. Teachers are still advised to use alternative online lab activities to keep learners engaged during online teaching by designing virtual laboratories such as videos, interactive simulations, and animations to illustrate laboratory experiences (Casanova et al., 2006). In Otjozondjupa, the teachers' efforts to compensate on practical work might have assisted learners if these learners had the necessary resources to receive or access them.

5.3.2.3 Sub-theme 2.3: Teachers' views on whether remote teaching of Chemistry was effective.

Chemistry teachers found the remote teaching and learning of Chemistry to be ineffective. In the questionnaires, around 85% of the teachers said that the implementation of Chemistry during the lockdown did not help in improving learners learning. The findings from both quantitative data and qualitative data obtained are corresponding. The primary reason that teachers gave for the ineffective implementation of Chemistry through remote teaching was that more learners were left out in the process of teaching and learning due to a lack of the necessary electronic gadgets through which they could receive the subject content and other educational information from their teachers. This challenge also hindered communication between the teachers and the learners, to share information and provide feedback on learning. Furthermore, the socioeconomic backgrounds of some learners, digital divide, and a lack of parental engagement in children's learning had a negative influence on the implementation of the Chemistry curriculum during the lockdown. Similarly, some learners' inability to comprehend the Chemistry content on their own and the teachers' inability to teach

Chemistry through conducting practical work in laboratories due to COVID-19 restriction negatively affected teaching and subsequently resulted in poor learning.

These finding concurs with Putra et al. (2020) who reported that in Indonesia, students faced difficulties learning at home during the lockdown due to a lack of resources, such as internet access, and parents' inability to support their children's learning at home. Similarly, it was found that teaching and learning was not effective in Zimbabwe because teachers found it difficult to reach and communicate with their learners (Nhatuve, 2021), thus they sent notes and activities to the learners but did not receive enough feedback to determine the learners' progress. However, in Georgia, it was reported that the quick transition to online learning was successful because teachers had already been using technology in teaching prior to the lockdown, and teachers and learners had access to the internet and electronic equipment required to conduct distance teaching and learning via Zoom and Google Classroom (Basilaia & Kvavadze, 2020).

5.3.2.4 Sub-theme 2.4: Teacher's views on whether they felt adequately equipped and empowered to implement Chemistry remotely.

The participants expressed in the interviews that they did not feel equipped neither were they prepared to implement the new curriculum for Chemistry remotely. They pointed out that this was due to lacking competencies in utilizing digital equipment, therefore they indicated that they should have received training on the usage of technology in teaching before shifting to distance education. The other factor mentioned was that some teachers did not have the resources required to make remote teaching work. One of Rogan and Grayson's (2003) theoretical construct "capacity to support innovation"

considers factors that either support or hinder the process of curriculum implementation in a school. In this instance, such factors included the availability of physical resources, the teachers' competencies to teach virtually and how teachers coped during the crisis.

Syomwene (2013) explains that several obstacles arise during the curriculum implementation process, including the curriculum itself, resources and facilities, and teacher preparation which makes implementation difficult to execute. Before shifting to the new mode of teaching, Chemistry teachers were supposed to be given appropriate training, even online, particularly on virtual teaching as well as be provided with the necessary physical resources they needed. The training would have assisted in equipping the teachers with the essential skills such as technological skills for effective implementation of the curriculum. Barbour et al. (2020) suggest that teachers must be familiar with online teaching in order to integrate technology into their classrooms and improve their daily practices. Additionally, for the teachers to react positively to the new mode of teaching to implement the subject successfully, they need support during the curriculum implementation journey. On this note, the MoEAC should have organised continuous professional development programmes or in-service training for the Chemistry teachers, especially in the first phase of distance learning.

5.3.2.5 Sub-theme 2.5: Teachers' views on the support they received from school management and Regional Office.

Participants commented being satisfied with the support the school management rendered to them during remote teaching. The quantitative data from questionnaires and the qualitative data from the interview data regarding the support teachers received from

the department of education at the regional office contradicted each other. Most teachers indicated in the questionnaires that they received support and guidance in forms of circular documents from the education department at the regional office. However, in the interviews, they gave opposite responses claiming that the support rendered to them was inadequate, and t it did not assist them in implementing the Chemistry curriculum during the lockdown. Furthermore, some Chemistry teachers expressed that no one from the advisory department tried to check how the remote teaching was being conducted. This finding implies that the implementation of the Chemistry curriculum was not monitored at the regional level during the COVID-19 lockdown.

Ngara et al. (2013) explain that when a new program is being implemented, those in charge of putting it into action require support services, guidance, and assistance to implement it meaningful. This involves advisory teachers, circuit inspectors and school management monitoring and supporting the implementation process within the school in accordance with the curriculum policy documents (Angula, 2015). Manson (2004) supports this viewpoint by stating that instructional leaders should help teachers understand educational policies, direct them through the implementation process, and motivate and monitor the teaching process. This would help identify the challenges and discrepancies teachers are experiencing in the implementation process, thus calling for interventions to assist and enhance the implementation of the Chemistry curriculum. Since most of the Chemistry teachers indicated that they expected more support from the education department, the advisory teachers should have created mechanisms to monitor the implementation process of the Chemistry curriculum. Similarly, instructional leaders at the education department were expected to provide sufficient continuous support to

the Chemistry teachers to cope with the difficulties they encountered in the implementation process. Rogan and Grayson (2003) also noted that for the teachers to implement a curriculum successfully, they should receive adequate support from stakeholders to ease the curriculum implementation journey.

5.3.3 THEME 3: Strategies on how Chemistry teachers could implement the new NSSCO Chemistry curriculum effectively during the COVID-19 national lockdown.

Teachers suggested the following strategies to help improve the implementation of the Chemistry curriculum during the COVID-19 national lockdown**.** The participants felt that there is a need for Chemistry teachers to be trained on the utilization of technology in teaching. All Chemistry teachers should be trained to use online learning platforms such as Google classroom and Zoom to conduct teaching online. Schools should be supplied with adequate resources to cater for both teachers and learners. Furthermore, each learner needs to be provided with a textbook. It was also suggested that the MoEAC should compile teaching and learning materials, including assessment activities for Chemistry to be distributed to all Chemistry teachers in the region so that they all cover the same specific objectives during remote teaching. This would lessen teachers' workload and ensure quality control of the teaching materials and assessment activities. There is also a need for greater collaboration between teachers and the parents. Parents are urged to be fully involved, offer the necessary support, and ensure that their children have study plans to continue learning at home during remote teaching.

5.4 Summary of the chapter

This chapter presented the discussion and interpretation of the findings on the challenges Chemistry teachers faced in implementing the Chemistry curriculum through remote teaching. The findings confirmed that teachers faced difficulties in the implementation of the Chemistry curriculum in Otjozondjupa region during the lockdown and these challenges impact the teaching and learning process negatively. Proper mitigations are needed so that should a similar crisis arise in the future, schools will be better prepared. The next chapter will present the summary, conclusion, and the recommendations, and the study research questions will be answered using the findings obtained.

CHAPTER 6: SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This chapter discusses the summary and conclusion of the study. It further presents the recommendations the researcher has made, and the areas identified for further research in the future.

6.2 Summary of the study

The study explored the challenges Chemistry teachers faced while implementing the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown. It investigated the challenges Chemistry teachers experienced, their views regarding the implementation process and it provides strategies that can mitigate these challenges to help improve the implementation of the Chemistry curriculum national crises.

The findings indicate that all teachers experienced several difficulties in their journeys of implementing the Chemistry curriculum remotely. However, the study further revealed that most Chemistry teachers demonstrated some innovations to remedy the situation with the limited resources. For instance, most teachers compiled notes and activities in forms of booklets. Some made videos of themselves explaining the subject contents which they sent to the learners through WhatsApp.

6.3 Conclusion

Rogan and Grayson's (2003) theory guided this study and directed the analysis of the data for the purpose of answering the study's research questions. The study agrees with Rogan

and Grayson's (2003) theory who noted that for a curriculum to be implemented successfully, there must be adequate resources and teachers should be provided with adequate training. It has been revealed in this study that teachers experienced various difficulties which acted as detrimental factors to teaching and learning during the lockdown. Some of these difficulties include inadequate resources, lack of teacher training, lack of digital competencies and poor teacher support from parents and the regional office.

It could be concluded from the findings that majority of secondary schools in Otjozondjupa Region were not suited for distance teaching and learning of Chemistry during the COVID-19 national lockdown. Due to the extent of the challenges that teachers encountered; the implementation of the Chemistry curriculum could not have been conducted successfully.

The conclusion is elaborated in conjunction with the research questions of the study as follow:

Research question One: *What are the challenges experienced by Chemistry teachers in the implementation of the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown?*

Resources: Most teachers reported a lack of resources, particularly the textbooks and the digital devices (laptops, smartphones, and tablets) required to conduct e-learning during the lockdown. Compounding this was a lack of internet access faced by most learners and some teachers during remote teaching and learning. The shortage of resources made the implementation of the Chemistry curriculum a difficult task for the teachers.

The main process of teaching and learning: The study revealed that Chemistry teachers experienced the following challenges about the main process of remote implementation of the Chemistry curriculum:

- Teachers and learners lacked digital competencies for utilizing technological tools in teaching and learning.
- Lack of commitment among some learners.
- Lack of motivation and unruliness among some learners.
- Incapacity of some learners to comprehend the Chemistry content on their own.
- Teachers' difficulty in explaining complex concepts of Chemistry to learners.
- Teachers' inability to conduct practical work.
- Difficulty reaching learners.
- Teachers' inability to cover planned coursework during the lockdown.

Assessment: The study revealed that teachers did not have a clear direction or guidance about exactly how they should administer assessment to learners remotely. Dishonesty and cheating among some learners were also detected which hindered the process of successful assessment practices. Another challenge that teachers encountered was the lack of learner accountability, who were handing in their assessment activities past the due dates or not handing them in at all.

Other challenges teachers experienced: The participants revealed other challenges encountered in the implementation of the Chemistry curriculum during the lockdown. These challenges include:

- Poor parental (guardian) support and involvement.

- Lack of communication between the teachers and the parents.
- Unequal opportunity in education for learners in terms of digital divide.
- Lack of support from the private sector.

It can be concluded that these challenges made it difficult for teachers to teach Chemistry effectively during the COVID-19 national lockdown.

Research question Two: *What are the views of Chemistry teachers on the implementation of the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown?*

Teachers' views regarding the strategy or instructional tool used: The study indicated that during remote teaching, most teachers used the strategy of compiling booklets which they handed out to the learners. In some cases, teachers complimented this strategy by sending learners recorded audios and videos with explanations on the contents via the WhatsApp platform.

*Teachers' views regarding conduction of practical work in Chemistry during remote teaching**:*** Teachers indicated that conducting practical work during the lockdown was challenging. Some teachers left out practical work until schools re-opened. A limited number of teachers had the resources to improvise by recording short videos of themselves showing some demonstrations or experiments which were sent to the learners through WhatsApp. In some cases, teachers instructed learners to search and watch videos on YouTube showing demonstrations of practical work on the topics covered. Nevertheless, there was a shortcoming which hindered the teachers' efforts as most of the learners did not have the gadgets and internet to access WhatsApp or go on YouTube.

Teachers' views on whether remote teaching of Chemistry was effective: Most teachers felt that the implementation of Chemistry during the lockdown was ineffective. They attributed this to the fact that many learners were left out of the teaching and learning process because of a lack of resources they needed to communicate with the teachers during the lockdown. Teachers were not able to reach all learners or cover all the content planned. What is more, most teachers lacked the competencies to operate technology in teaching. Practical work which is a vital part of teaching and learning Chemistry was not conducted due to laboratories that were out of reach. The other reasons are that some learners were not committed, and some lacked cognitive abilities to study on their own, so their study efforts were limited. All the aforementioned problems imply that the remote teaching of Chemistry had resulted in learning gaps among learners.

Teachers' views on whether they felt adequately equipped and empowered to implement the Chemistry curriculum remotely: Most teachers asserted that they did not feel equipped, empowered, or prepared to teach Chemistry remotely, because they did not have skills to use technology in teaching. Some also indicated that they were not in possession of the resources needed to implement distant teaching. Moreover, the teachers stated that they did not receive training on the new mode of teaching which would have equipped them with skills to implement the curriculum.

Teachers' views regarding the support they received from school management and Regional Office: The study established that during remote teaching, Chemistry teachers received some guidance via circulars, but they were not given enough support with in-service training and continuous professional development. Furthermore, teachers stated there was no monitoring of the implementation of the curriculum, particularly from the

advisory department at the regional office. Contrastingly, the study found that teachers were satisfied with the support the school management rendered them.

Research question Three: *How can the Chemistry teachers effectively implement the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown?*

Teachers suggested the following strategies to help improve the implementation of the Chemistry curriculum during remote teaching:

- Teachers should be trained on the use of technology in teaching to have the needed competencies for remote teaching.
- All schools should be supplied with sufficient resources for both teachers and learners to ensure successful implementation of the curriculum.
- All learners should be in possession of textbooks.
- The MoEAC should create teaching and learning materials as well as assessment activities for Chemistry that should be distributed to all the schools.
- There should be more collaboration between the teachers and the parents regarding the learners' education.
- Parents and guardians should become more involved in their children's learning and oversee study plans for them.

6.4 Recommendations of the study

Based on the findings of the study, the researcher presents the following recommendations to alleviate the challenges teachers expressed in this study:

6.4.1 Recommendations for Chemistry teachers

- Chemistry teachers should empower themselves in digital competencies in technology by participating in professional development programme in technology pedagogical knowledge. This will equip them with digital skills to use technology in education (teaching) so they can be better prepared for future remote teaching needs, or simply for the purpose of integrating technology to support their everyday teaching practices.
- Teachers should be innovative in designing exciting lessons which provide more opportunities for teacher-learners interaction during remote teaching with an effort to enhance learner-teacher engagement. This may also lessen the feeling of isolation among the learners.
- Teachers should be more supportive, motivating and encouraging towards learners to support them during times where they must conduct their learning at home.
- When using technology in remote teaching, teachers should use and interact with learners through the technology that is less expensive and that learners are already likely to be acquainted with, for example, WhatsApp.
- Chemistry teachers should assist in identifying and referring learners that may have lost a parent or a relative to COVID-19 to the Life Skill teachers for counselling and psychological support.

6.4.2 Recommendations for School managements

- School principals and heads of departments should continuously engage teachers, increase support, and provide guidance and motivation to increase commitment to providing quality education in such a difficult time.
- Continuously check in with teachers and develop mechanisms to assist teachers in keeping their mental and emotional health in check, to reduce professional anxiety.
- Ensure that teachers have adequate lesson planning before conducting remote teaching, but also provide sufficient planning time, since it is more demanding to plan for distance learning.
- Appeal for funds from the government to purchase laptops or tablets for the schools so teachers can access them and are not forced to use their own resources.

6.4.3 Recommendations for the Ministry of Education, Arts and Culture

- Institutional support is necessary for teachers when it comes to resources. Teachers have revealed that most schools in Otjozondjupa Region faced a lack of resources such as equipped laboratories and technological tools. The absence of these resources not only create negative perceptions amongst the teachers concerning their profession, but it also disempowers teachers and the learners particularly, in remote teaching. This could result in low morale and reduces enthusiasm to teach and learn. Therefore, the MoEAC should avail funds so that this resource deficit is filled, and all teachers have the requisite materials to reduce learning disparities within the region.

- Provide digital devices and data bundles through the schools to vulnerable and disadvantaged learners for the duration of remote teaching and learning.
- The MoEAC should develop instructional materials and assessment activities to be used by all teachers. This will not only help lessen teachers' workloads, but it will also help with teaching content quality control and the assessment activities given to the learners.
- Provide pedagogical training programme to Chemistry teachers on the usage of technology or electronic resources in the online situation for the purpose of improving their digital skills as well as provide training on the best approaches to remote teaching.
- Provide teachers with clear guidance on how to cover the practical aspects of Chemistry instruction and how they should administer assessment to monitor learners' progress during the remote learning.
- Train teachers on how best they can support disadvantaged and vulnerable learners as they seemed to have suffered the most throughout distance learning which might have deter inclusive education during the lockdown.
- Given the current changes brought by the COVID-19 pandemic, there is a need for the MoEAC to review and include mechanisms for implementing a curriculum in schools in line with these new trends.
- The MoEAC should take an initiative of providing literacy programme to communities especially in rural areas and low-income societies on digital skills and on how parents and guardians can best support their children's mental and emotional health during distance learning.

- Develop innovative ways to deal with crises such as the COVID-19 pandemic to ensure that education continues to be carried out smoothly on a distance mode.

6.4.4 Recommendations for Otjozondjupa Regional Council (Advisory Department)

- Advisory teachers should give Chemistry teachers full support in the implementation journey of the curriculum during distance teaching. This will enable them to determine if teachers are effective and subsequently assist them where they may be lacking.
- It should provide Chemistry teachers with an ongoing professional programme to help them improve their abilities to implement the curriculum successfully in the new mode of teaching.
- It should link Chemistry teachers with one another in the region so that they can engage and share constructive ideas on how to make remote teaching a success.
- It should provide teachers with support services for their socio-emotional and mental health as there is likely to be a danger of teachers experiencing a lot of stress. In this way, teachers can have an outlet to express themselves regarding the difficulties while receiving the necessary counselling on how to overcome any challenges they may be experiencing. Ng (2007) found that when teachers experience pessimism, it impacts their teaching and in turn learners are at a great disservice.

6.4.5 Recommendations for parents and the community

- All parents and guardians should support teachers and the MoEAC by taking ownership and increasing involvement in their children's education, after all, it is their obligation. They can do this by overseeing that learners have study plans and ensuring that there is open channel of communication between all three parties: the learners, the parents, and the teachers. Parents should also try and create conducive environments where learners can carry out their education activities with minimum disturbances.
- Parents that can afford should provide their children with digital devices such as smartphones and tablets to communicate with their teachers to continue learning effectively while at home. (For the disadvantaged learners, the MoEAC should provide).
- Parents who have the capacity, should improve their skills and knowledge on the usage of technology in learning, so they can serve as supportive links between the teachers and the learners.

6.4.6 Recommendations for further research studies

- The study was limited to only one region, Otjozondjupa. Hence, it is hoped that similar further studies will be conducted in other regions on the same subject or focusing on other subjects as well.
- The study only investigated challenges experiences by teachers. However, it is important that difficulties faced by learners and parents are also explored. Therefore, future research can include learners and parents as that will give them

voices to express the challenges they faced and how to create effective learning environments during distance teaching and learning.

6.5 Summary of the chapter

The study found that teachers faced numerous challenges in implementing the Chemistry curriculum during the lockdown on multiple fronts, including, a lack of resources, specifically textbooks and the technological devices needed for remote teaching, lack of skills in remote teaching, inability to conduct practical work, difficulty conducting assessment, poor learner motivation and interest, poor parental engagement and support, and generally complications teaching the Chemistry subject online.

The study also revealed that Chemistry teachers did what they could, with the tools they had to continue teaching in compliance with the MoEAC's directive for learners to continue receiving education through remote teaching during the lockdown. Due to the challenges that teachers faced, there is a high likelihood that learners did not receive sufficient instruction during the COVID-19 lockdowns, and this may have led to learning gaps.

The study further reveals that Otjozondjupa Region is lacking regarding remote teaching and learning at secondary schools. The factors outlined in the study that acted as barriers to effective remote teaching were too immense to conduct remote teaching successfully. It is credible then to say that most of secondary schools in Otjozondjupa were not equipped for remote teaching during the lockdown.

The study concluded with recommendations the researcher has suggested on how different stakeholders in education could meet the challenges experienced by the Chemistry teachers in the curriculum implementation. This includes: the provision of adequate resources, in-service training, or continuous professional development programme to acquire digital skills and encouraging parents to take more proactive steps in ensuring their children's' educational development. The researcher envisions that if the suggested recommendations are taken into consideration and acted upon, the situation can improve. This will result in schools and teachers being in better positions to execute remote teaching and learning during similar pandemics or crises, which would enable learners to continue learning effectively.

Problems were experienced while conducting this study. The researcher encountered difficulties to secure appointment with some participants, hence the researcher had to try several times before securing appointments. On top of that, not all questionnaires were returned from the participants as some claimed to have misplaced them.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE CERTIFICATE

UNAM
UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: SoE-DEC100621/12 Date: 28 June 2021

This Ethical Clearance Certificate is issued by the University of Namibia Decentralised Research Ethics Committee (DEC) in accordance with the University of Namibia's Research Ethics Policy and Guidelines. Ethical approval is given in respect of undertakings contained in the Research Project outlined below. This Certificate is issued on the recommendations of the ethical evaluation done by the Faculty/Centre/Campus/Unit Research Ethics Committee.

Title of Project: CHALLENGES CHEMISTRY TEACHERS FACE IN IMPLEMENTING THE NEW NSSCO CHEMISTRY CURRICULUM IN OTJOZONDJUPA REGION DURING THE COVID-19 NATIONAL LOCKDOWN

Nature/Level of Project: MASTERS

Researcher: JOSEPHINE HAFENI

Student Number: 200256149

Faculty: EDUCATION & HUMAN SCIENCES

School: EDUCATION

Take note of the following:

(a) Any significant changes in the conditions or undertakings outlined in the approved Proposal must be communicated to the DEC. An application to make amendments may be necessary.
(b) Any breaches of ethical undertakings or practices that have an impact on ethical conduct of the research must be reported to the DEC.
(c) The Principal Researcher must report issues of ethical compliance to the DEC (through the Chairperson of the Faculty/Centre/Campus/Unit Research Ethics Committee) at the end of the Project or as may be requested by DEC.
(d) Approval is valid for a period of one year from the date of issue.
(e) A mid-year report to be submitted to DEC (where applicable).
(f) The DEC retains the right to:
    (i) Withdraw or amend this Ethical Clearance if any unethical practices (as outlined in the Research Ethics Policy) have been detected or suspected,
    (ii) Request for an ethical compliance report at any point during the course of the research.

DEC wishes you the best in your research.

....

Dr Helena Miranda
SoE-DEC Chairperson

UNIVERSITY OF NAMIBIA
2021-06-28
DIRECTOR
RUNDU CAMPUS

APPENDIX B: RESEARCH PERMISSION LETTER FROM THE UNIVERSITY

CENTRE FOR RESEARCH SERVICES
Office of the Pro-Vice Chancellor: Research, Innovation & Development
University of Namibia, Private Bag 13301, Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneers Park, Office F223 - F-block, Second Floor
☎ +264 61 206 4673; E-mail:kmbulu@unam.na; URL: http://www.unam.edu.na

13 July 2021

RESEARCH PERMISSION LETTER

Student Name: JOSEPHINE HAFENI

Student number: 200256149

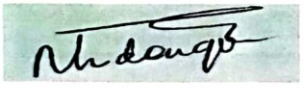
Programme: MASTER OF EDUCATION BY RESEARCH

Approved research title: CHALLENGES CHEMISTRY TEACHERS FACE IN IMPLEMENTING THE NEW NSSCO CHEMISTRY CURRICULUM IN OTJOZONDJUPA REGION DURING THE COVID-19 NATIONAL LOCKDOWN

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

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

Best Regards



CENTRE FOR RESEARCH SERVICES
Office of the Director
2021 -07- 15
University of Namibia
UNAM

Prof. Nelago Indongo
Director: Centre for Research Services

APPENDIX C: LETTER OF APPROVAL FROM THE EXECUTIVE DIRECTOR IN THE MINISTRY OF EDUCATION, ARTS AND CULTURE

REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION, ARTS AND CULTURE

Enquiries: Mr. G. Munene
Tel: +264 61 -2933202 2
Fax: +264 61- 293392
Email: Gibson.Munene@moe.gov.na
File no: 13/2/9/1

Luther Street, Govt. Office Park
Private Bag 13186
Windhoek
Namibia

Ms Josephine Hafeni
Email: josephinehafeni@gmail.com

Dear Ms Hafeni,

SUBJECT: PERMISSION TO CONDUCT ACADEMIC RESEARCH IN OTJOZONDJUPA REGION

The Ministry wishes to acknowledge receipt of your letter dated 4 July 2021 seeking for permission to conduct academic research at schools for your Masters studies which is focusing on: *"Challenges Chemistry Teachers Face in Implementing the New NSSCO Chemistry Curriculum in Otjozondjupa Region during the COVID-19 National Lockdown."*

Permission has been granted to you. However, you have to seek for further clearance from the Otjozondjupa Regional Director of Education, Arts and Culture in the region to ensure that:

- the school principals are aware of your presence;
- teaching and learning should not be interrupted;
- participation is voluntary;
- you obtain consent from parents of learners under 16 years old.

Furthermore, you are kindly requested to share your research findings with the Ministry after completion of the research project. You may contact Mr G. Munene on the above provided contacts at the Directorate: Programmes and Quality Assurance (PQA) for submission of your research findings at the above indicated details.

We wish you the best in conducting your research and the Ministry looks forward to hearing from you upon completion of your studies.

Yours sincerely,

Saret L. Steenkamp
EXECUTIVE DIRECTOR

Ministry of Education, Arts and Culture
Office of the Executive Director
05/07/2021
05 JUL 2021
Tel: 061-2933523/4
Fax: 061-253671
Private Bag 13186 Windhoek Namibia

All official correspondence must be addressed to the Executive Director

APPENDIX D: LETTER OF APPROVAL FROM THE DIRECTOR OF EDUCATION FOR OTJOZONDJUPA REGION

Republic of Namibia

Otjozondjupa Regional Council

DIRECTORATE OF EDUCATION, ARTS AND CULTURE
Private Bag 2618, OTJIWARONGO, Tel +264 67 308000, Fax +264 67 304871

Ref: *14/6/10*

07 July 2021

P.O. Box 2526
OKAHANDJA
Namibia

Dear Ms. Hafeni

SUBJECT: REQUEST FOR PERMISSION TO CONDUCT AN EDUCATIONAL RESEARCH IN SCHOOLS IN OTJOZONDJUPA REGION

Your letter dated 05 July 2021 bears reference and is hereby acknowledged.

Regarding the above mentioned subject, the Directorate of Education, Arts and Culture is pleased to inform you that approval is granted as per your request to conduct a research in the Region. The school principals and Inspectors of Education will be notified of the approval by copy of this letter.

You are kindly requested to make sure that the research to be conducted at schools should by no means whatsoever disrupt teaching and learning.

We hope and trust this exercise will enhance quality education in the region.

Your cooperation in this regard will be highly appreciated.

Yours faithfully

OTJOZONDJUPA REGIONAL COUNCIL DIRECTORATE OF EDUCATION OFFICE OF THE DIRECTOR 2021 -07- 12 PRIVATE BAG 2618 OTJIWARONGO OTJOZONDJUPA REGION

MS. J. MUTENDA
REGIONAL DIRECTOR

All official correspondence must be addressed to the Chief Regional Officer

APPENDIX E: TEACHERS' QUESTIONNAIRE

HREC-NH Annex 5G: Questionnaire
QUESTIONNAIRE

Dear Participant

1. My name is Josephine Hafeni, student number 200256149. I am studying towards a Master of Education (by Research) degree at the University of Namibia (UNAM), and I am conducting a survey about the *Challenges Chemistry teachers face in implementing the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown.*
2. I have selected you to participate in my study, because you belong to the group of people I want to include for my research. I would therefore like to invite you to complete this questionnaire.
3. The research I am conducting has been approved by the UNAM Research Ethics Committee. I would appreciate it very much if you would complete this questionnaire, and I would like to assure you of the following:
    a. You do not have to fill in this questionnaire if you do not want to.
    b. You can stop filling in the questionnaire and stop participating at any time if you want to, and there will be no negative consequences for you.
    c. Your participation is anonymous. You are not required to provide your name on this questionnaire. This means that, even if I ask information that might identify you or if I know you, I am not allowed to make your identity known to anyone. When I report on my questionnaires' data and results, I will not mention any personal information about participants that might identify them.
    d. All completed questionnaires and data will be stored in a safe and secure place, and only authorised University officials, my supervisor and I will have access to it. After five years, all the questionnaires and data will be destroyed in an environmentally friendly way.
4. If you have any questions about this questionnaire, or if you do not understand anything, please feel free to ask me, and I will be happy to explain it to you.
5. If you want to know more about the research I am doing, please feel free to ask me, and I will be happy to tell you more.
6. It should take about 25 minutes for you to complete the questionnaire.
7. You can reach me on my cell phone at 0811422122, or send an e-mail to josephinehafeni@gmail.com
8. If you want to contact the UNAM Centre for Research Services for more information or because you have a comment or complaint about this research or about me, please call (+ 264 61) 206 4673, or write an e-mail to research@unam.na. Please provide specific information.
9. Thank you very much for your willingness to participate in this research!

Please detach this page and keep it.

Please turn over to start filling in the questionnaire.

Dear Chemistry teacher

Please respond to this questionnaire as honestly and completely as possible. The data to be collected will strictly be used to compile the report for my research study.

Section A: Biographic Information

1. What is your gender? Please mark with an [**X**] in the appropriate box

Male	
Female	

2. How old were you on your last birthday? _____years
3. What is/ are your qualification/s to teach Chemistry/ Physical Science? (Cross more than one if necessary)

A.C.E in Physical Science	
Teaching diploma in Physical Science	
Education degree in science	
Bachelor of Science	
Master's degree in Science Education	

If other qualification, please specify

---

4. How many years of teaching experience do you have? Please mark with an [**X**] in the appropriate box

0-3	
4-6	
Above 6	

5. Is Chemistry your subject of specialization? Please mark with an [**X**] in the appropriate box

Yes	
No	

6. How many subjects do you currently teach? _____ subjects

7. What is the average number of leaners in the Chemistry class(es) that you teach? Please cross only one box.

Less than 20	
21-30	
31-40	
41-50	
More than 50	

8. What is your school's location? Please mark with an [**X**] in the appropriate box

Rural	
Urban	

9. Availability of facilities at your school to aid the implementation of the new Chemistry curriculum. Please mark with a cross [**X**] all that apply.

Equipped science laboratory	
Computer laboratory	
School library	
Internet connectivity	
Electricity	
Photocopy machine	

Others, please specify

_____

Section B: Closed- ended Questions

1. **Challenges experienced by Chemistry teachers in the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown.**

   To what extent do you **agree** or **disagree** with the following statements. **SD**= Strongly Disagree; **D**= Disagree; **U**= Undecided; **A**= Agree, **SA**= Strongly Agree. Please circle your response.

Statements	**SD**	**D**	**U**	**A**	**SA**
Chemistry teachers were not prepared to implement the new NSSCO Chemistry curriculum virtually	1	2	3	4	5
Chemistry teachers lack skills in utilizing technological devices in remote teaching	1	2	3	4	5
Chemistry teachers felt overwhelmed with work in implementing the new NSSCO Chemistry curriculum virtually	1	2	3	4	5
There is a lack of technological devices and internet connection for the teachers	1	2	3	4	5
There is a lack of technology devices and internet connection for the learners	1	2	3	4	5
Every learner has equal cognition ability to receive virtual teaching	1	2	3	4	5
The Chemistry teacher lacked competencies in fostering interaction with the learners during remote teaching	1	2	3	4	5
A lack of hands-on activities and experiments hindered effective teaching and learning of Chemistry during the lockdown	1	2	3	4	5
Remote teaching and learning have created new cost burdens for the learners and their parents	1	2	3	4	5

2. **Views of Chemistry teachers on the implementation of the NSSCO Chemistry curriculum during the COVID-19 national lockdown.**

   2.1 Views of Chemistry teachers regarding their confidence toward the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown.

How did you feel about the implementation of the new NSSCO Chemistry curriculum during through remote teaching? Please **circle** only **one** choice. **Y**=Yes **N**= No

Statements	**Y**	**N**
I am satisfied with the way the Chemistry curriculum was implemented through remote teaching during the lockdown	1	2
The implementation of the Chemistry curriculum during the lockdown has assisted in improving learners' learning	1	2
I found the remote teaching of Chemistry to be unfulfilling	1	2
The implementation of the Chemistry curriculum through remote teaching was demanding in terms of my time, energy, planning and teaching	1	2
I felt insecure about implementing the Chemistry curriculum through remote teaching	1	2

2.2 Views of Chemistry teachers on their preparedness to implement the new NSSCO Chemistry curriculum during COVID-19 national lockdown.

Indicate your **agreement** or **disagreement** to the following statements by circling your response, using this scale **SD**=Strongly Disagree, **D**=Disagree, **U**=Undecided, **A**=Agree, **SA**=Strongly Agree

Statements	**SD**	**D**	**U**	**A**	**SA**
I had used technological devises in teaching Chemistry prior the lockdown	1	2	3	4	5
I had prior knowledge regarding remote teaching	1	2	3	4	5
I received helpful guiding policies on how to conduct remote teaching of Chemistry	1	2	3	4	5
I received sufficient in-service training in content knowledge and teaching methods before the remote implementation of the new Chemistry curriculum	1	2	3	4	5

2.3 *Views of Chemistry teachers regarding learners' abilities and attitudes towards the implementation of the new NSSCO Chemistry curriculum during COVID-19 national lockdown.*

Indicate your **agreement** or **disagreement** to the following statements by circling your response using this scale **SD**=Strongly Disagree, **D**=Disagree, **U**=Undecided, **A**=Agree, **SA**=Strongly Agree

Statements	**SD**	**D**	**U**	**A**	**SA**
Learners studying Chemistry showed eagerness to continue learning during the lockdown	1	2	3	4	5
Learners were completing and submitting the activities given to them on time during the lockdown	1	2	3	4	5
Learners struggled to understand the content of Chemistry through remote teaching and learning	1	2	3	4	5
Learners felt isolated in their learning during the lockdown	1	2	3	4	5

2.4 *Views of Chemistry teachers on parental involvement and support toward the implementation of the new NSSCO Chemistry curriculum during the lockdown.*

Indicate your **agreement** or **disagreement** with the following statements by circling your response, using the following scale

N=Never, **S**=Seldom, **SO**= Sometimes, **O**=Often, **AA**=Almost Always

Statements	**N**	**S**	**SO**	**O**	**AA**
Parents assisted their children with learning during remote teaching	1	2	3	4	5
Parents were actively involved in their children's education	1	2	3	4	5
Parents were eager to obtain information about their children's progress from the teacher	1	2	3	4	5
Parents took part in school decision making process when required	1	2	3	4	5

2.5 *Views of Chemistry teachers regarding the support from school management toward the implementation of the new NSSCO Chemistry curriculum.*

Indicate your **agreement** or **disagreement** to the following statements by circling your response using this scale: **SD**=Strongly Disagree, **D**=Disagree, **U**=Undecided, **A**=Agree, **SA**=Strongly Agree

Statements	**SD**	**D**	**U**	**A**	**SA**
School management supported teachers with adequate resources required in remote teaching of Chemistry	1	2	3	4	5
School management identified staff development needs and addressed them timely	1	2	3	4	5
School management virtually monitored remote teaching and learning during the lockdown	1	2	3	4	5
School management communicated clearly and in a timely way with the teachers regarding remote teaching	1	2	3	4	5
School management promoted teamwork among teachers and encouraged teachers throughout	1	2	3	4	5

2.6 *Views of Chemistry teachers regarding the support from the Regional Office toward the implementation of the new NSSCO Chemistry curriculum.*

Please circle your response. **N**=Never, **S**=Seldom, **SO**=Sometimes, **O**=Often, **AA**=Almost Always

During COVID-19 national lockdown, the Regional Office provided the following support and assistance in form of the following to the Chemistry teachers:

Statements	**N**	**S**	**SO**	**O**	**AA**
Virtually monitored the implementation of the new NSSCO Chemistry curriculum effectively during the lockdown	1	2	3	4	5
Communicated with the Chemistry teachers constantly in order to assist them with their needs regarding remote teaching	1	2	3	4	5
Linked Chemistry teachers in the region with one another to share ideas on virtual lesson delivery	1	2	3	4	5

Provided Chemistry teachers with clear guidance regarding remote teaching of Chemistry	1	2	3	4	5
Provide helpful guidance on how to support learners' socio-emotional well-being during the lockdown	1	2	3	4	5

Thank you for your help and contribution.

APPENDIX F: TEACHERS' INTERVIEW GUIDE

HREC-NH Annex 5B Individual Interview
INDIVIDUAL INTERVIEW

Dear Participant

10. My name is Josephine Hafeni, student number 200256149. I am studying towards a Master of Education by Research degree at the University of Namibia (UNAM), and I am conducting interviews about the *challenges Chemistry teachers face in implementing the new NSSCO Chemistry curriculum in Otjozondjupa Region during the COVID-19 national lockdown.*

11. I have selected you to participate in my study, because you belong to the group of people I want to include for my research. I would therefore like to invite you to an interview.

12. The research I am conducting has been approved by the UNAM Research Ethics Committee. I would appreciate it very much if you would participate in an interview, and I would like to assure you of the following:

    a. You do not have to participate in an interview if you do not want to.

    b. You can stop participating in the interview before the end and leave at any time if you want to, and there will be no negative consequences for you.

    c. Your participation is completely anonymous. This means that, even if I ask information that might identify you or if I know you, I am not allowed to make your identity known to anyone. When I report on my interview data and results, I will not mention any personal information about participants that might identify them. Should I refer to a specific participant, I will use a system of coding, e.g. "Respondent A is of the opinion that …".

    d. If I want to make any (audio or video) recording of you during the interview, I have to get your permission to do so. You are free to decline to have the interview recorded, and there will be no negative consequences for you. I will then record the contents of the interview in my notes only.

    e. All interview data will be stored in a safe and secure place, and only authorised University officials, my supervisor and I will have access to it. After five years, all the data will be destroyed in an environmentally friendly way.

13. If you have any questions about this interview, or if you do not understand anything, please feel free to ask me, and I will be happy to explain it to you.

14. If you want to know more about the research I am doing, please feel free to ask me, and I will be happy to tell you more.

15. The interview should take about 30-35 minutes.

16. You can reach me on my cell phone at 0811422122, or send an e-mail to josephinehafeni@gmail.com if you have any questions about this research.
17. If you want to contact the UNAM Centre for Research and Publications for more information or because you have a comment or complaint about this research or about me, please call (+ 264 61) 206 3061, or write an e-mail to research@unam.na. Please provide specific information.
18. Thank you very much for your willingness to participate in this research!

Every Participant should receive a copy of this page.

PERMISSION FOR AN INDIVIDUAL INTERVIEW

SECTION 1: DETAILS OF INTERVIEWER

Name and surname: Josephine Hafeni

Student number: 200256149

SECTION 2: DETAILS OF THE INTERVIEW

Date of interview:	
Place of interview:	
Type of recording:	
Record reference:	
Start time:	
End time:	

SECTION 3: DETAILS OF THE INTERVIEWEE/PARTICIPANT

Name and surname:	
Cell phone number:	
E-mail address:	

SECTION 4: DECLARATION BY THE INTERVIEWEE/PARTICIPANT

I, (*name and surname of Interviewee/Participant*) ……
declare that:

- I am 18 years of age or older.
- I am participating voluntarily in this interview, and I understand that I can leave at any time before the end of the interview without any negative consequences for me.
- I understand that I provide my details in Section 3 above ONLY for record purposes for this research, and that the information will not be shared with a third

party or used to communicate with me about anything else than this research project.

- I understand that my identity will be fully protected in any report on this research, and that all information I provide above and during the interview will be safeguarded.
- I AGREE / DECLINE to being recorded during the interview in the manner stated in Section 2 above. (*Delete the non-applicable word.*)

……. ……

……..

SIGNATURE: Participant SIGNATURE: Interviewer

DATE

1. **Introduction**

Dear Chemistry teachers

Please respond to the interview questions as honestly and completely as possible. May I have your permission to audio record our conversation? The data to be collected will strictly be used to compile the report for my research study.

2. **Interview questions**

2.1 Challenges Chemistry teachers experienced in implementing the new NSSCO Chemistry curriculum during COVID-19 national lockdown.

- *Resources:* What challenges did you experience in terms of resources as well as information and technology required for you to implement Chemistry effectively through remote teaching during the lockdown? How did you address these challenges?
- *Remote teaching:* What challenges did you encounter during the process of teaching and learning of Chemistry, during the national lockdown? How did you address these challenges?
- *Assessment:* What challenges did you encounter as you assessed learners in Chemistry during the national lockdown? How did you handle these challenges?
- What other challenges did you experience in implementing the new NSSCO Chemistry curriculum during the COVID-19 national lockdown?

2.2 Views of the Chemistry teachers on the implementation of the new NSSCO Chemistry curriculum during the COVID-19 lockdown.

- What strategies or instructional tool(s) did you find most useful in delivering remote teaching of Chemistry during the lockdown? Elaborate on your answer.
- Practical work is an essential element of teaching the subject Chemistry. How did you go about implementing this part of the Chemistry curriculum during remote teaching?
- Do you think that the implementation of the new NSSCO Chemistry subject through remote teaching during the COVID-19 lockdown was effective? Give reasons for your answer.

- Did you feel adequately equipped and empowered to implement the Chemistry curriculum effectively via remote teaching? Given the circumstances, what did you do to improve the implementation of this curriculum during the lockdown?
- What support did you receive from the school management and regional office towards successful implementation of the Chemistry curriculum during the lockdown? Which support did you find to be most helpful to you?

2.3 How can Chemistry teachers effectively implement the new NSSCO Chemistry curriculum in Otjozondjupa region during the COVID-19 national lockdown?

Are there any other issues that you consider worth mentioning that I have not asked you about the implementation of the new NSSCO Chemistry curriculum during the COVID-19 national lockdown?

Thank you for your time.