TEACHERS' USE OF TEACHING AND LEARNING SUPPORT MATERIALS FOR EFFECTIVE TEACHING OF GRADE 11 CHEMISTRY AND PHYSICS IN KAVANGO EAST REGION, NAMIBIA

A DISSERTATION SUBMITTED IN FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN SCIENCE EDUCATION

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BY

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Abstract

The purpose of this study was to investigate teachers' use of Teaching and Learning Support Materials (TLSMs) for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region, Namibia. Four research questions were generated to guide the collection of data. The study adopted the sequential mixed methods research design which employed both quantitative and qualitative approaches. The quantitative approach employed Likert scale closed-ended survey questionnaires while the qualitative approach employed follow-up interviews and live classroom observations to address the research questions. The quantitative data was analyzed using descriptive statistics and then presented using tables and graphs, while the qualitative data were analyzed using the thematic analysis method. The study sample included all the twenty-one Chemistry and Physics teachers teaching in Senior Secondary Schools, and one Science Education Officer (SEO) in the Kavango East Region. Thus, the total population sampling method was used to select the sample. The study found that there are different ways in which Chemistry and Physics teachers in the Kavango East Region used different TLSMs for effective teaching of the subjects in Grade 11. The study found that the teachers mainly used TLSMs to help their learners acquire quality knowledge construction and enduring memory of Chemistry and Physics concepts taught (71% of the participants agreed and 19% strongly agreed), and to instill scientific skills of handling apparatus in the learners (71% of the participants' agreed and 14% strongly agreed). Furthermore, the participants (76% agreed and 19% strongly agreed) indicated that they use TLSMs to arouse learner's attention and enhance their concentration during the lesson, and to facilitate guided interactions between the learners (57% agreed and 14% strongly agreed). However, the study revealed that several factors constrained the teachers from using

TLSMs for effective teaching of Grade 11 Chemistry and Physics in the area. These include teachers' lack of pedagogical knowledge in using TLSMs to effectively teach Grade 11 Chemistry and Physics, scarcity of TLSMs (textbooks 95%, photocopy papers 87%, past exam papers 90% and lack of internet excess 83%), overcrowded classrooms, poor English as a Second language, lack of well-equipped school laboratories, and lack of training workshops. As indicated by the participants, the possible intervention measures that can support the Chemistry and Physics teachers to use TLSMs for effective teaching of these subjects in the study area include provision of teachers' in-service training through Continuous Professional Development, provision of well-equipped science laboratories, and provision of relevant TLSMs. Findings from the live classroom observations also revealed that the teachers need training on the best practices of using TLSMs and methods to achieve the desired teaching objectives. Therefore, the study recommended that the SEO should provide regular capacity building workshops for the Chemistry and Physics teachers based on innovative usage of TLSMs to enable them to effectively teach the subjects. Furthermore, the Ministry of Education, Arts and Culture should provide adequate relevant TLSMs as well as equip Chemistry and Physics laboratories in the schools in order to avail teachers the needed TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area.

List of publication(s)/conference(s) proceedings

This publication is from this current research

1. Andreas M. S, James A, Shobo, A, B. & Percy M. (2023). The Ways Science Teachers Use Teaching and Learning Support Materials for Effective Teaching of Grade 11 Chemistry and Physics in Kavango East Region, Namibia, (*Under review, Science Education International*).

Table of contents

List of Tables

List of Figures

List of abbreviations and acronyms

A Agree

AS Advisory services

B.Ed. Bachelor of Education

BECTA British Educational Communications and Technology Agency

BETD Basic Education Teacher Diploma

CPD Continuous Professional Development

D Disagree

EDoMoEAC Executive Director of the Ministry of Education Arts and Culture

GDE Gauteng Department of Education

HCl hydrochloric acid or hydrogen chloride

ICI Information and Communication Infrastructure

ICTs Information and Communication Technologies

IK Indigenous Knowledge

IT Information Technology

IUM International University of Management

JHS Junior High School

JSP Junior Secondary Phase

KC Knowledge Communities

KERDEAC Kavango East Regional Directorate of Education, Arts and Culture

LCE Learner-Centred Education

M.Ed. Master of Education

MASTEP Mathematics and Science Teachers Education Programme

MOE Ministry of Education

MOEAC Ministry of Education Arts and Culture

NAMCOL Namibian College of Open Learning

NaOH Sodium Hydroxide

NCBE National Curriculum for Basic Education

NIED National Institute for Educational Development

NNCBE Namibia National Curriculum for Basic Education

NSSCO Namibian Senior Secondary Certificate Ordinary Level

NUST Namibia University of Science and Technology

OHP Overhead Projectors

PBL Project-Based Learning

PGDE Postgraduate Diploma in Education

RO Regional Office

SA Strongly Agree

SD Strongly Disagree

SEO Science Education Officer

SHS Senior Higher Secondary

SSP Senior Secondary Phase

TCE Teacher Centred Education

TEIs Teacher Education Institutions

TLSMs Teaching and Learning Support Materials.

TPCK Teachers' Pedagogical Content Knowledge

TPCs Tablet Personal Computers

TSK Teacher's Subject Knowledge

USB Universal Storage Bus

Acknowledgements

At the outset and notable, a gallop has come to its culmination, and in the last moments of proofreading and editing this dissertation, I have come to recognise there are several people who deserve a mention of gratitude starting with the Almighty God for his protection in all years and the Schleittwein Foundation PhD Scholarship for sponsoring my study to make my dream a reality. Secondly, special thanks are due to my main supervisor, Prof. James Abah whose efforts secured this full scholarship for my study, and for providing me the needed guidance successfully. My immense gratitude also goes to my co-supervisor, Dr. Adedamola Shobo, for his availability 24/7 with constructive criticism and guidance, as well as the University of Namibia's Postgraduate Studies. It has been wonderful working with them, and they taught me many things during my three years of study with the University of Namibia. I have enjoyed their enthusiasm, spirit, and support throughout the years. But above all, I have been able to take from them important lessons which are: patience, honesty, support for one another and sacrifices, because with them everything was possible. Thirdly, I appreciated the support I received from the Ministry of Education Arts and Culture (Executive Director), Kavango East Regional Directorate of Education (Regional Director), Science Education Officer (Chemistry, Physics) school principals, Grade 11 Chemistry and Physics teachers, other teachers, community members and the learners at large. Lastly, I am also massively thanking members of my family (especially my wife Mrs. Magdalena Kasekere Shifafure) for her understanding during numerous sleepless nights and my friends who have supported in my comings and goings throughout the years. There were times when I was in uncertainty about my occupation, lacking the needed resources.

For that I am thankful.

Dedication

This dissertation is dedicated to my wife (Kasekere Magdalena Shifafure), my daughter (Mudi Brigitha Shifafure) and my sons (Johannes Kaveto Shifafure, Andreas Muronga Shifafure & Rafael Rafael Shifafure), my mother, my late father and the other members of my family. They all care about my wellbeing and were very encouraging to me.

Declarations

I, Andreas Muronga Shifafure, hereby declare that this Dissertation: *Teachers' use of Teaching and Learning Support Materials for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region, Namibia* 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 a degree at any other institution.

Andreas Muronga Shifafure		15/04/2024
Name of Student	**Signature**	**Date**

CHAPTER ONE: INTRODUCTION

1.1 Background of the study

The main goal of this study was to investigate teachers' use of Teaching and Learning Support Materials (TLSMs) for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region, Namibia. TLSMs are tools used by teachers, educators and instructors in schools to facilitate learning and understanding of concepts among students (Radhika, 2019). The Namibian Ministry of Education's National Curriculum for Basic Education (NCBE) (2016) states that TLSMs are important and helpful reference materials for Chemistry and Physics teachers, learners and curriculum developers in Namibia. From the researcher's experience, both as a former student in secondary school, and now as a teacher, there are many benefits in the usage of TLSMs for effective teaching of Grade 11 Chemistry and Physics. As emphasized in the new curriculum for the Namibian Senior Secondary Certificate Ordinary Level (NSSCO) Chemistry and Physics (2018), scientific skills and knowledge acquisition require advanced technology through the efficient and effective use of TLSMs and processes. According to NCBE (2016), TLSMs materials in Chemistry and Physics includes books, posters, charts, recycled waste materials and Information and Communication Technologies (ICTs) used in the classroom. However, all these materials require ample knowledge and skills on their usage for effective teaching of Chemistry and Physics in the classroom. Learners would be exposed on the manipulation and handling of laboratory apparatus.

The Ministry of Education (2016) emphasized that TLSMs can add important structure to Chemistry and Physics lesson planning and the delivery of instruction, and act as a guide for teachers. Currently, there is dearth of data about Chemistry and Physics teachers' actual classroom usage of different TLSMs for effective teaching and learning of Chemistry and Physics at secondary schools, especially in the Kavango East Region of Namibia. Inferences drawn from the NSSCO Chemistry and Physics Examiners report (2015-2018) suggest that there is very little to no meaningful utilization of TLSMs by Chemistry and Physics teachers to improve teaching and learning outcome in this region. Tety (2016) had pointed out that effective Chemistry and Physics teaching and learning cannot occur in the classroom environment if essential teaching and learning materials are not available nor used by the teachers. In poor-resourced schools, the availability and actual use of different TLSMs might be a constrain to Chemistry and Physics teachers. Thus, it became pertinent to investigate how Chemistry and Physics teachers make use of different TLSMs to effectively teach Grade 11 Chemistry and Physics in the Kavango East Region, Namibia.

1.2 Statement of the problem

TLSMs are the primary reference materials for effective teaching and learning in Grade 11 Chemistry and Physics (NSSCO Syllabus, 2018). However, different examiners' reports have indicated that many Chemistry and Physics learners in the Kavango East Region could not connect materials procedurally (NSSCO Examiners Report, 2015-2018). This suggests that the Chemistry and Physics teachers in the

Kavango East Region might not be effectively using TLSMs in their teachings to expose their learners and enable them (learners) to connect theories and applications.

Furthermore, the examiners' report revealed that many learners were unable to correctly identify related tools in the examinations. For example, many learners labeled "beaker" as "jar" (NSSCO Examiners Report, 2015-2018). Thus, there appears to be a gap between the expected knowledge transfer by the teachers and knowledge applied by the learners. Moreover, the effective teaching of Chemistry and Physics using the correct resources such as TLSMs is supposed to enhance learning outcomes. Unfortunately, there is no documented study to show how Chemistry and Physics teachers are using TLSMs to effectively teach the subjects in the Kavango East Region. This creates a literature gap and thus, makes it difficult to identity and plan relevant intervention measures that could support the teachers' usage of TLSMs for effective teaching of Grade 11 Chemistry and Physics in the area. Therefore, this study investigated how Chemistry and Physics teachers make use of TLSMs to effectively teach Grade 11 Chemistry and Physics in the Kavango East Region, Namibia.

1.3 Research questions

The study was guided by the following research questions:

1. In what ways do Chemistry and Physics teachers make use of different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?

2. What factors constrain Chemistry and Physics teachers from using different TLSMs to effectively teach Grade 11 Chemistry and Physics contents in the Kavango East Region?
3. What are the views of the Chemistry and Physics teachers, and Science Education Officer (SEO) on the use of different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?
4. How can the Chemistry and Physics teachers be supported to improve their uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?

1.4 Significance of the study

Firstly, the study results would benefit Chemistry and Physics teachers, curriculum developers, and the Ministry of Education, Arts and Culture by equipping them with research-based information on the usage of different TLSMs for effective teaching of Grade 11 Chemistry and Physics. Such information is critical for identifying and planning intervention measures to enhance effective teaching of Chemistry and Physics at secondary schools in the study area. Secondly, the study would provide useful insights into the ways Chemistry and Physics teachers use TLSMs for effective teaching of Grade 11 Chemistry and Physics as well as the factors that constrain teachers' usage of TLSMs in the study area. It would also provide insight into how the teachers could be supported to improve their usages of TLSMs to effectively teach Grade 11 Chemistry and Physics. Finally, the study might pave ways for further research on the use of different TLSMs for effective teaching of Chemistry and Physics in other regions of Namibia, which will add to scientific literature, more Namibia context of the research area.

1.5 Limitation of the study

There were challenges of scarcity of documented literature relating to Chemistry and Physics teachers' uses of TLSMs in Kavango East Region and Namibian schools at large. Therefore, the reviews were mainly the international literature on the use of TLSMs with the study context. Moreover, being a full-time employee as a teacher which might affect the time needed to be in the field during data collection. Therefore, the researcher took leave during the data collection which provided sufficient time to be away from the duty station and concentrate fully on the field work without any distraction.

1.6 Delimitation of the study

This study dealt with teachers' uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region Namibia only. Therefore, results of the study may not be generalized to all the regions in Namibia. The challenge encountered during the pilot study was that teachers were busy with syllabus completion for Grade 11 Chemistry and Physics as well Grade 12 Advanced Subsidiary Level. Thus, the researcher consulted and set up dates that are most convenient for the participants until the pilot study was completed.

1.7 Operational definition of terms as used in this study

Student/learner: In the context of this study student/learner refers to an individual who is willing to learn and understand new things through understanding and acquiring knowledge of new things or concepts.

COVID-19: COVID-19 stands for coronavirus disease which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). COVI-19 is an acute disease characterized mainly by fever and cough but is capable of progressing to severe symptoms and in some cases death, especially in older people and those with underlying health problems. It was originally identified in China in 2019 and became pandemic in 2020.

Social distance: It is a measure of staying at home and away from other people as much as possible (+-1.5 m away) to help prevent spread of COVID-19.

TLSMs: In this study, TLSMs referred to the materials used by Grade 11 Chemistry and Physics teachers in the classroom setting to make their teaching more effective and understandable to the learners.

Chemistry and Physics teacher: This refers to the teacher teaching Grade 11 Chemistry and Physics in a secondary school in the Kavango East Region. In this region, one teacher is usually appointed to teach both subjects in a school; hence, the term Chemistry and Physics teacher as used in the study.

Effective teaching: the ability to be useful, supportive, and valuable in assisting learning. In this study, effective teaching is regarded as the correct way of using TLSMs to support the normal classroom teaching of the subject contents to enhance learners' understanding.

Information and Communication Technology (ICT): refers to technologies such as YouTube that provide access to scientific information through videos on using TLSMs from the internet which are likely to contribute to effective teaching of Grade 11 Chemistry and Physics.

Learner-Centred Teaching Method: refers to the teaching whereby learners are more actively involves, hands on, use and manipulate TLSMs and analyses their learning as a results of their experimental finding.

Discussion Teaching Method: This type of teaching involves both learners being actively involved and interacts with one another during the real life situations and use the TLSMs in their disposals to make the concepts more understanding to the learners.

1.8 Summary

This chapter discussed the background of the study followed by the statement of the problem, research questions, significance of the study, limitations, and delimitations of the study. Lastly, the chapter outlined the operational definitions of some terms/concepts as used in the study.

The next chapter present the literature reviewed in this study in relation to investigating teachers' use of TLSMs for effective teaching of grade 11 Chemistry and Physics as well as other relevant literature on scientific investigations.

CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2. 1. Introduction

This chapter provides a review of the literature relevant to this study. The literature reviewed was based on the concept of Teaching and Learning Support Materials (TLSMs), the types TLSMs used by Chemistry and Physics teachers, ways in which Chemistry and Physics teachers made use of different TLSMs for effective teaching. Furthermore, the review was based on factors that constrain Chemistry and Physics teachers from using different TLSMs, views of Chemistry and Physics teachers on the use of different TLSMs for effective teaching of Chemistry and Physics, and how can Chemistry and Physics teachers be supported to improve their uses of TLSMs for effective teaching. Lastly, the theoretical framework which guided the study was discussed.

2.2.1 The Concepts of TLSMs

According to Nasaza (2016), TLSMs are called various names depending on different authors; some refer to them as instructional materials, learning materials, curriculum materials, teaching and learning resources. TLSMs are regarded as a more generic term and include non-print learning materials (e.g. materials for the study of science, design and technology, and computer software such as CD-ROM-Computer disc-read only memory) (National Institute for Educational Development (NIED), 2008). These are generally the materials used to assist teachers to facilitate teaching and learning. Elom (2014) noted that TLSMs are any devices with

instructional contents or functions that can be used for teaching and learning purposes, and may include magazines, charts as well as pictures, which are used to supplement and complement the teacher's work. Moreover, (Oladejo, Olosunde, Ojebisi, & Olawale, 2011) stated that instructional materials are in different categories such as audio or aural, visual, or audiovisual. According to Oladejo *et al.* (2011), audio instructional materials refer to those devices that make use of the sense of hearing only such as radio, audio tapes recorders and television. In addition, they stated that visual instructional materials are those that engaged the sense of sight only such as chalkboards, charts, slides, and filmstrips. Also, audiovisual instructional materials refer to both audible range and seeing such as television, motion pictures and the computer. Langwenya-Myeni (2017) also describes teaching resources as the different kinds of materials that teachers and learners use in the teaching and learning processes to achieve effectiveness and productivity. He further asserts that TLSMs include resources, equipment and materials which the teacher can use to achieve lesson objectives. The Gauteng Department of Education (GDE) (2012) in its teaching and learning Policy defines TLSMs as all the materials that facilitate teaching and learning in schools, including materials for learners with special educational needs.

Moreover, according to the study conducted in Nigeria by Philip and Denwigwe (2017), instructional materials and instructional media are now used to mean every material or equipment which was formerly referred to as teaching aid, instructional aid, and audio-visual aid. In another study, Klemm, Schumann, Udhardt, and March (2001) described instructional materials as information carrying technologies that are used for instructional purposes with the hope of delivering education information

very quickly and very vividly too. In another study, Denwigwe (2017) defined instructional materials as devices which present a complete body of information and largely self-supporting rather than supplementary in the teaching-learning process.

The National Curriculum for Basic Education (NCBE), (2016) outlined that effective learning and teaching are closely linked to the effective use of teaching and learning materials (for example; books, posters, charts, and recycled waste materials) and ICTs (for example; computers as well as audio and visual media) in the classroom. Therefore, the teacher must select and develop the most appropriate materials and media to support teaching and enhance learning. The NCBE (2016), further states that wider knowledge sources must be readily available in the school library, through software as well as the internet, and that it may be necessary and sometimes preferable for teachers to improvise by finding teaching and learning materials from easily available and inexpensive objects in the immediate environment.

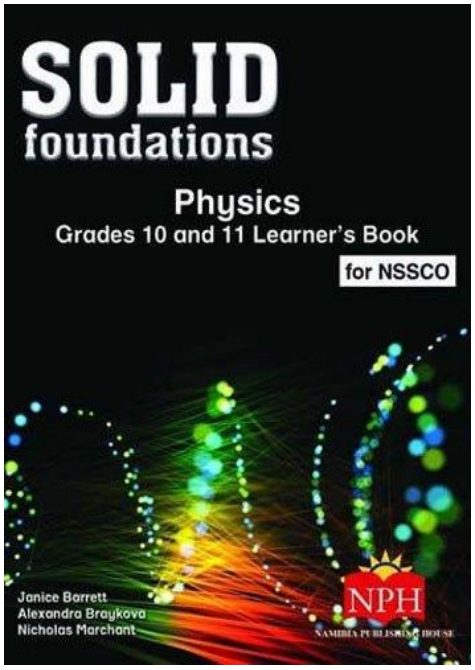
2.2.2 Types of TLSMs

This section presents the different TLSMs reviewed to guide this study in line with the research questions underpinning the study.

2.2.2.1 Textbooks

Textbooks constitute the most widely used TLSMs that teachers frequently use during classroom instruction to improve learners' understanding. For example, Figures 1 shows the front cover of the popular Chemistry and Physics textbooks

widely used in teaching the subjects at senior secondary schools in Namibia which are also endorsed by the Namibia College of Open Learning (NAMCOL).



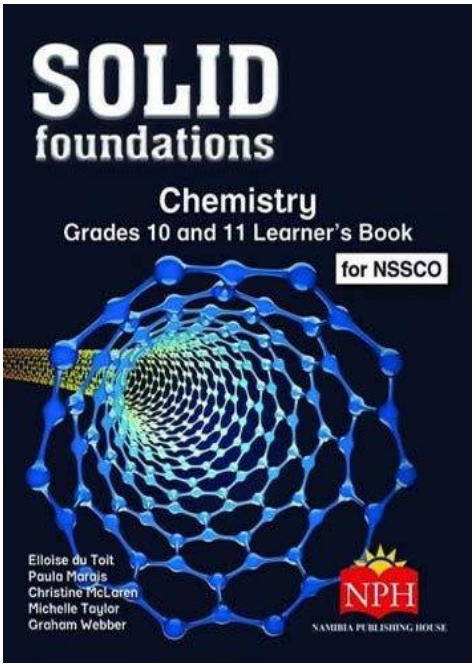


Figure 1 a) Physics Textbook **b)** Chemistry Textbook

According to Gradana (2017), textbooks are standard reference materials for formal teaching and learning of a subject. He further adds that textbooks are TLSMs that teachers can draw upon in creating an effective teaching of their lessons and may offer a framework of lesson guidance and orientation. Textbooks may provide confidence and security for an inexperienced teacher especially for tailored work-related courses.

The National Institute for Educational Development (NIED) (2008) in the Namibian National Textbook Policy outlined that textbook as TLSMs often highlight what learners need to learn and be taught; and what teachers should base their lessons on and choose lesson contents from. The policy document further states that without the use of recommended textbooks as teaching aids, many teachers may not be able to

effectively teach school subjects in some developing countries, where adequate teacher training may be lacking. Thus, textbooks are thus indispensable resources for effective teaching and learning, especially in science subjects such as Chemistry and Physics.

According to Aloovi (2018), the value of textbooks as TLSMs in driving the teaching of science has been well documented. The author remarks that in majority of classrooms, textbooks become "the classroom, and determine what is taught and learned about science in these classrooms". Moreover, textbooks help to translate the intentions of the curriculum into classroom practice by reflecting the goals of science learning, such as understanding the nature of science and science content; developing inquiry skills; and understanding the interrelationship between science, technology, environment, and the society. The quality of textbooks, therefore, has a great impact on the quality of instruction or teaching and learning (Lemmer, Edwards & Rapule, 2008 as cited in Aloovi, 2018).

Furthermore, Aloovi (2016) argues that although textbooks are good sources of information, they are mostly abused by teachers as most teachers use them as the only source of teaching support. In this way, learners tend to be separated from concrete sources of knowledge, such as materials in the environment from which relevant information can be gained (Aloovi, 2016). This makes it difficult for most learners to apply their knowledge to real life situations outside of the classroom. While in many cases textbooks may work perfectly without the need for much adaptation, different levels of adaptation may be needed in others (Aloovi, 2018). Aloovi (2018) further explains that through the process of adaptation, the teacher

should have the knowledge on how to personalize the contents, making it a better teaching resource by individualizing it for a particular group of learners. Normally this process takes place gradually as the teacher becomes more familiar with the textbook because the dimensions of the text that need adaptation may not be apparent until the book is tried out in the classroom by the subject teacher (Aloovi, 2016).

According to Basturkmen (2010), textbooks as teaching and learning materials have some advantages namely; it provides a syllabus for the course because the authors of the syllabus have made decisions about what will be learned and in what order; it provides security for the students because they have a kind of road map of the course, they know what to expect, what they know and what is expected from them. Additionally, Basturkmen (2010) added that; it provides a set of visuals, activities, readings and so saves the teacher's time to find or developing such materials; and it provides teachers with a basis for assessing students' learning. Some textbooks include tests or evaluation tools, support materials (teacher's guide, electronic version, worksheets, and relevant videos), and provide consistency within a program across a given level, if all teachers use the same textbook.

On the other hand, textbooks also have limitations, e.g. textbooks predigest material and so deny the learners the need to think, organize and arrive at independent conclusion, which may lead to teachers' and learners' dissatisfaction with the course. Basturkmen, (2010) stated that some frequently stated disadvantages of using only ready-made textbooks include contents or examples that may not be relevant or appropriate to the group and they may not reflect the students' needs since textbooks are often written for global markets. Moreover, textbook often do not speak to the

interests, needs and realities of a specific students' group; they may contain incomprehensible language, since texts/terms, dialogs and other aspects of content may confuse learners and some not well-exposed teachers (Basturkmen, 2010).

2.2.2.2 Chalkboard

Figure 2 shows a typical chalkboard used as a TLSM in Namibian schools.

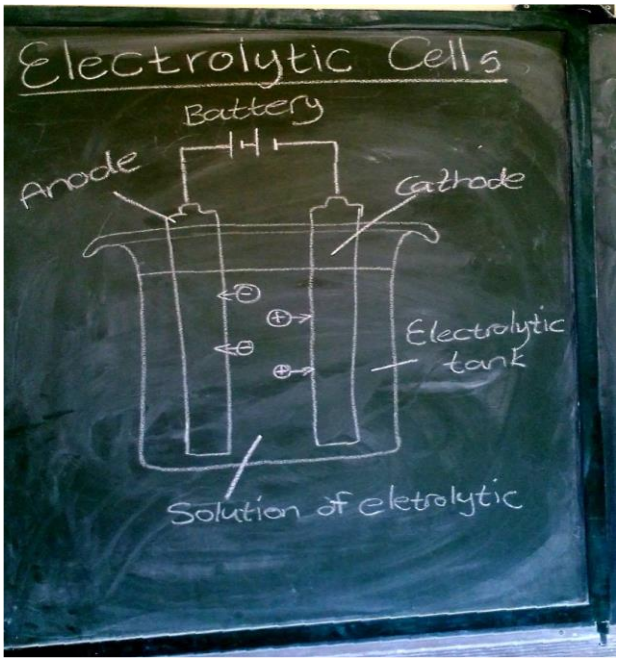


Figure 2. A photo of the chalkboard used as TLSM in a school lesson.

Thoa (2013) describes chalkboard as smooth hard panels, usually black or green or white, used to write something with a piece of chalk and are mainly used for teaching purposes in educational institutions. Nowadays, white marker boards are gradually replacing the traditional chalkboards. Furthermore, chalkboards are enlarged 'scribbling pads' and are the oldest as well as best-known teaching aid or TLSM. It is essential for all educators to master the techniques of using them for the explanation of a problem or for a quick calculation for the whole class to see what is going on

(Frieda, 2016). The chalkboard is a site of display (Wylie, 2012) where teachers and students collaboratively create a text based on a previous text, usually the textbook. Jones (2009:115) stated that "the site of display (chalkboard) is always used to take real-time social actions in the context of particular social practices". Additionally, Ranga (2013) opined that the use blackboard (chalkboard) as a form of TLSMs is a must for teaching in schools and colleges. Though the advancement of technology has produced highly visual interactive boards to replace traditional chalkboards, their high cost prohibits their full adoption in all schools and thus makes the chalkboard still relevant (Ranga, 2013).

Buchanan (2018) noted that the use of chalkboards as a TLSM in teaching improves teaching effectiveness, classroom management and student academic success. Furthermore, Ranga (2013) stated that writing on a chalkboard makes it easier to control the pace of a lesson because it encourages writing while talking, a task that requires instruction at a moderate speed. According to Govender and Moonsamy (2018), students need time to assimilate new information and to take notes, but if you speak too slowly, they may become bored. As a result, teachers are expected to vary the pace to suit their own style, their message and their audience to help control the amount of content students receives as it is being outlined on the chalkboard. Teaching with chalkboard allows content to unfold naturally. It eliminates the urge to force-feed information.

In a study conducted by Qamhieh, Benkraouda, and Amrane (2013) using blackboard in an introductory Physics course at United Arab Emirates University (UAEU), it was reported that blackboard usage did not only benefit the interactions between the

students and the instructors but that it also improved the students' attitude towards Physics learning. It was additionally noted that disruptive students may become less disturbing if they are within a teacher's visibility as a result of chalkboard usage (Qamhieh, *et al*., 2013). They added that visual aids that require lights off hinder teacher's ability to monitor students' behavior while using the chalkboard. Advantageously, visual reinforcements, like diagrams, can be displayed on a chalkboard to keep students' attention and sometimes, students are more willing to engage in a classroom setting if they believe what they are learning on the chalkboard has real value (Buchanan, 2018). Also, Buchanan (2018) adds that students that see teachers construct diagrams on a chalkboard witness the process of turning written information into visual information and learn faster. Therefore, teachers should emphasize the importance of practical skills when using teaching materials and its potential applications on the chalkboard as a TLSM.

Nyabana (2016) reported improved performance of students who frequently interact with chalkboard as a teaching and learning tool. The author further explained that teaching by writing information on a chalkboard helps teachers take visible cues from students and can immediately address students' challenges by observing their body languages and facial expressions that suggest confusion about the material displayed on the chalkboard. For that reason, teaching with chalk and chalkboard is especially an advantage for teachers of students with mixed learning abilities. Govender and Moonsamy (2018) asserted that a teacher of students with various learning needs must have flexibility within his or her teaching style using the chalkboard; to effectively teach the students and some necessary adjustments may include not sticking to the lesson plan if students are not grasping the material

written on chalkboard. According to a University of Michigan study on note taking (n.d), student notes are often incomplete and/or inadequate if the chalkboard is not used effectively. Therefore, the notes a teacher writes on the chalkboard are essential to a student's understanding and increases the chances of students taking correct notes. Likewise, using chalkboard as TLSMs helps in getting students to participate actively in the lesson which makes class more enjoyable for teachers and students alike (Thoa, 2013). On the other hand, Frieda (2016) expounds that teachers can have students write on the chalkboard to display their understanding of course material. Moreover, students may also take advantage of note-writing session to physically identifying their areas of confusion or present alternative perspectives on the chalkboard which may benefit their peers (Frieda, 2016).

2.2.2.3 YouTube videos

According to Pecay (2017), YouTube is among the popular platforms in social media in today's digital age. Its popularity and the directive to integrate ICT in the curriculum, presents a myriad of benefits for the improvement of science education and thus, science teachers are encouraged to utilize it in the teaching and learning processes. In modern teaching practices, teachers rely on YouTube videos to clarify concepts in lessons that they find challenging to explain so as to enhance their science instruction (Matzat & Vrieling's, 2016).

Thalluri and Penmann (2015) explains that YouTube is an internet-based video-sharing platform which allows users to upload user-created contents onto a customized YouTube Channel and it has an algorithm which presents a list videos

related to a user's interests. Though YouTube videos can be very helpful in studying science concepts where actual observations are essential, its application may be hampered due to limited resources or other factors (Kotluk & Kocakaya, 2016). In addition, YouTube videos do not only benefit the viewer but also the content creator, especially for pre-service science teachers and teacher education institutions (TEIs) (Kotluk & Kocakaya, 2016). For instance, Havlik (2014) alluded that in a module on polymer chemistry, students were given the option to make a YouTube video instead of writing a magazine-style article. He explained that the students found making videos (YouTube) more enjoyable than those who wrote articles and also gained further educational benefits such as development of public engagement and presentation skills; enhancement of individual scientific creativity; and even becoming empowered as global science educators in their own right. Moreover, the highly interactive nature of YouTube science videos which allows viewers' comments provides the audience with a voice and the creator with feedback on the effectiveness of the videos. As such, an online learners' community (You Tube) spontaneously emerges (Smith, 2014). Jaffar (2012) supplemented that the use of video streaming media, such as YouTube *in* the science classroom is important to be considered as an alternative scientific educational tool to promote students' engagements in science lessons. However, Havlik (2014) cautioned that as forums like YouTube and Facebook become news generators, students need guidance on how to find accurate and reliable sources of scientific information in science education. Thus, the use of video technology YouTube directly as part of classroom instruction to introduce new concepts and to explain concepts during main or close instruction has the potential to enhance students' learning (Koto, 2020).

Furthermore, the availability of YouTube as a new set of tools for science teaching and learning has become a promising means of supporting student learning and engagement for certain reasons (Churchill, 2009 as cited in Koto, 2020). The integration of YouTube videos in the science learning process supports students' engagement and results in enhancing students' participation in the classroom (Sherer & Shea, 2011), and increasing students' achievement in learning (Jones & Cuthrell, 2011).

Moreover, Koto, Harneli and Winarni (2018) stated that modern technology, e.g. YouTube, needs to be integrated into the classroom teaching and learning process in order to develop the students' scientific skills required in the new digital society. Therefore, science teachers need to combine video technology with appropriate learning goals and tasks (Krauskopf, Zahn & Hesse, 2012).

2.2.2.4 Information Communication Technology (ICT)

According to Ratheeswari (2018), Information and Communication Technology (ICT) refers to technologies that provide access to information through telecommunication, similar to Information Technology (IT) but focuses primarily on communication technologies including the internet, wireless networks, mobile phones and other communication media. He further described the term Information and Communication Technologies as the computer and internet connections which may be used to handle and communicate information for teaching and learning purposes. Ghavifekr and Rosdy (2015) added that ICT in education refers to the use of computer-based communication that is incorporated into daily classroom

instructional process. The authors further stressed that ICT integration in education generally means technology-based teaching and learning processes that are closely related to the utilization of learning technologies in schools.

Information and communication technologies consist of hardware, software, network and media for collecting, storing, processing, transmitting and presenting information (voice, data, text and image) as well as related services (Talebian, Mohammadi & Rezvanfar, 2014). These authors asserted that ICTs can be divided into two components: Information and Communication Infrastructure (ICI) and Information Technology (IT). Sarkar (2012), clarified that the former (ICI) refers to physical telecommunication system and network (cellular, voice, mail, radio and television) while the latter (IT) refers to hardware and software of information collection, storage, processing and presentation.

ICT is considered as a powerful tool for educational change and reform in teaching and learning and is being applied successfully in instruction, learning, and assessment (Fu, 2013). In a study conducted in India by Sharma, Garg, and Mittal (2014), it was reported that the educational society has become so immersed in technology as teaching tools that it is nearly impossible to simulate the learners without ICT being used in the classroom during teaching. Furthermore, Sharma et al. (2014) explained that many studies report an improvement in pupils' motivation and attitude towards learning, shown through an increased commitment to the learning task and greater interest in the subject as they use ICT integration in teaching and learning processes.

Ghavifekr and Rosdy (2015) stated that ICT provides the help and complementary supports for both teachers and students where it involves effective teaching and learning with the help of the computers serving the purpose of teaching and learning aids. This works well in almost all ranges of subjects including Mathematics, Science, Languages, Arts and Humanity, and other major fields can be learned more effectively through technology-based tools and equipment (Ghavifekr & Rosdy, 2015).

Findings from the research carried out in Australia asserts that ICT tools do not serve as replacements for quality teachers but rather, they serve as add-on supplements needed for better teaching and learning (Jamieson-Proctor, Albion, Finger, Cavanagh, Fitzgerald, Bond & Grimbeek, 2013). The need for ICT integration in education is crucial because it affords the opportunity of teaching and learning to take place not only in the physical school environment but also anywhere and even with physical distance between teachers and students (Jamieson-Proctor et al., 2013).

According to Jamieson-Proctor et al. (2013), ICT can be used in various ways where it helps both teachers and students to learn about their respective subject areas. Furthermore, Chien, Wu and Hsu (2018) held that technology-based teaching and learning offers various interesting pathways (which include educational videos, stimulation, storage of data and the usage of databases. Furthermore, mind-mapping, guided discovery, brainstorming, music, and World Wide Web (www)) to make the teaching and learning processes more fulfilling and meaningful (Chien, Wu & Hsu, 2018). Moreover, students will benefit from ICT integration where they are not bounded to the limited provision of the curriculum and available resources.

Furthermore, hands-on activities provided in a technology-integrated course can help to stimulate learners' understanding of the subject (Chien *et al*., 2018). According to the study carried out in Northwest China, ICT also helps teachers to design their lesson plans in an effective, creative and interesting approach that results in students' active learning (Zhang, 2017). Other previous researchers proved that the use of ICT in teaching enhances the learning process and maximizes the students' abilities in active learning (Jamieson-Procter *et al*., 2013). For example, the use of Microsoft PowerPoint can be used to present the topic in a very innovative and creative way that could facilitate classroom discussion and exchange of ideas/thoughts between the teacher and students.

According to Balanskat, Blamire and Kefala (2016), there is considerable research-based evidence that learners are more highly motivated when their learning is supported through the use of ICT tools. For example, using computers in science teaching makes learners to be more engaged in activities by the show of increased interest and demonstrated longer attention span (Lee, Hong, & Hwang, 2017). The integration of ICT tools in the science classrooms however requires careful planning for it to meet the intended teaching/learning objectives by providing access to a huge range of resources that are of high quality and relevant to scientific learning (Lee *et al*., 2017). Furthermore, Philip and Denwigwe (2017) affirmed that the use of multi-media resources enables visualization and manipulation of complex models, three dimensional images and their corresponding movements to enhance the understanding of scientific ideas. Philip and Denwigwe (2017) also added that teachers use ICT to widen the range of resource materials which may be used in teaching and learning. ICT tools make use of texts, still and moving images, and

sound to increase the variety of ways that learning materials can be used for whole class and individual learning (Manqele, 2012). Lee *et al*. (2017) noted that the use of ICT tools affords teachers the opportunity of meeting the needs of students with diverse learning styles, and thus promotes an inclusive classroom environment. Additionally, the use of ICT tools in classroom instruction allows teachers with different teaching styles to modify instructional materials and their presentation for individual adaptation (Osborne & Hennessy, 2007). Likewise, Bransford, Brown and Cocking (2016) posited that teachers use ICT to improve the quality of information available to students. This is possible since teachers are able to glean up-to-date information from the internet which is related to the specific topic/subject. Additionally, Ghavifekr and Rosdy (2015) reported that efficient usage of ICT tools correctly, like computers, allows repetitive tasks to be carried out quickly and accurately so that more time can be spent on thinking about the scientific relevance of data generated. These authors emphasized that the use of ICT can therefore extend learning beyond the teaching space and class contact time and thus place it at the heart of the learning process rather than as an additional peripheral experience. Moreover, Zhang (2013) explained that during teaching and learning, ICT tools provide opportunities for teachers to be creative in their teaching and in learners learning. Furthermore, the use of the internet and ICT tools in education has been the subject of research, both in relation to students' learning as well as to teachers' pedagogical practices (Ghavifekr, Razak, Ghani, Ran, Meixi & Tengyue, 2014). New technologies can be used to support and foster learning to create situations based on real-world problems brought to the classroom as well as to create opportunities for feedback and reflection, construction of learning communities and expansion of learning opportunities for teachers (Bransford *et al*., 2016). Finally, literature has

revealed that the use of ICT tools in teaching has a strong motivational effect on students (Balanskat *et al*., 2016). According to Osborne and Hennessy (2007), the use of ICT in science classes benefit students in developing their critical thinking skills, handling and collection of data as well as by increasing their access to knowledge presented in a visual format, raising motivation and engagement.

2.2.2.5 Laboratory equipment

Figure 3. Photo of some Glass wares commonly used in science laboratories.

According to Philip and Denwigwe (2017), TLSMs include items found in the science laboratory (in this case, Physics or Chemistry) which are used by teachers to facilitate effective learning outcomes among students. In a typical school's Chemistry laboratory (see Figure 3 above), such instructional materials include

thermometer, glass rod, filter paper, lens, porcelain boat and copper, clock glass, pipette, burette. On the other hand, typical equipment in a school's Physics laboratory include venire calipers, micrometer screw gauges, spring balances, pendulum bobs, standard masses, mechanical pulleys, prisms, magnets, tuning forks, gold-leaf electroscopes, ammeters, voltmeters and galvanometers. According to Gokmen, Gurkan and Katırcıoglu (2021), the laboratory equipment in the science classroom has long been used to involve students in concrete experiences with objects and concepts. The laboratory materials have won its place in school and its introduction has proved successful, it is designed to revolutionize education where learners goes out from our laboratories able to see and do using laboratory equipment's (Gokmen et al, 2021). In addition, a classification of goals for laboratory materials in science education helps to arouse and maintain interest, attitude, satisfaction, open-mindedness and curiosity in science learners (Hansen, Spittle, Chen, Poe, Zhang, Klein, & Sangoro, 2020). Moreover, Hansen et al. (2020) explained that laboratory materials help to develop creative thinking and problem-solving ability, critical thinking and the scientific method of manipulating laboratory equipment. Aydin (2011) stated that laboratory manual is a key component of learning in the laboratory and the laboratory manual contains variety of laboratory equipment's which plays a major role for most teachers and students in defining goals and procedures for laboratory activities. It also helps focus observations and the development of inferences, explanations, and other activities in laboratory investigations (Bin, 2012).

2.2.3 Advantages of using TLSMs

According to Tuimur and Chemwei (2015), the usage of TLSMs in classroom has the potential to help the teacher explain new concepts clearly resulting in better students' understanding of the concepts being taught. In the same vein, Stefanc (2012, 175) added that "TLSMs provide an enormous deal of teacher's capacity to put across a message to learners in an accurate, proper, clear and understandable manner in making an abstract knowledge concrete and in enabling learners to comprehend complex ideas through simplification". Eshetu (2015) supplemented by referring to audio-visual materials as TLSMs which provide tangible basis for conceptual thinking and give rise to meaningful concepts enriched by meaningful associations, hence TLSMs offer the best solution for the disease of verbalism only. However, Nasaza (2015) stressed that it is the role of the teacher to harness the thoughts of the learners so that they focus their attention on the training programme and get as much benefit from it as possible.

TLSMs attract the attention of students in what is being taught. Ayoti and Poipoi (2013) outlined that teaching and learning materials such as pictures, specimens of flowers and the likes, attract the interest of students and will let them pay attention to what is being taught. Ayoti and Poipoi (2013) further explained that TLSMs make it easier for students to understand what they are taught. When students see, touch and hear what they are learning about, they understand it better. Moreover, Aina (2013), and Adeyemo (2010) believe that one major reason for poor performance among students might not be separated from the abstract nature of the courses they are taught. Aina and Adeyemo (2010) are of the view that the absence of TLSMs such as

real objects or pictures makes it difficult for students to understand communicated information. This is because young learners usually lack the ability to assimilate concept abstractly making it imperative to adopt the use of interactive materials.

In addition, Oladejo (2011) explains that mastery of Physics concepts cannot be fully achieved without the use of instructional materials. TLSMs are used to supplement verbal explanation of concepts or any description so that the lesson could be real to the students. Oladejo (2011) stressed that the primary purpose of instructional materials is to make learning more effective and facilitate it. Teaching with objects offers latitude for shaping lessons to students' interests and needs, thereby enhancing the potential of these strategies to be realized in the classroom (Sieber & Hatcher, 2012). Thus, in order to make the learning experiences of the learners more concrete and realistic, teachers have to use and prepare specific teaching materials which help teachers to clarify, establish and correlate concepts being taught (Sieber & Hatcher, 2012).

TLSMs can also promote student-student interaction, student-teacher interaction, and teacher-student interaction, if pre-instructional planning incorporates principles such as stimulus variation, feedback, reinforcement, learner's participation, and so on (Temechegn, 2012). The author emphasized that TLSMs save teaching time as they require short-time to present large information. Thus, with appropriate TLSMs, learners' interest can be aroused, maintained, and stimulated to promote their imaginative power. The relevance of TLSMs in the teaching-learning situations should no longer be over emphasized. Many research evidences confirm that TLSMs can be used to enhance teaching and learning (Tuimur & Chemwei, 2015).

According to Philip and Denwigwe (2017), TLSMs usage can provide a concrete basis for conceptual thinking, stimulate high degree of student's interest in lesson, and provide the necessary basis for developmental learning. Hence make learning more permanent, offer a reality of experience which stimulates self-activity on the part of the pupils, provide experience not easily secured by other materials and contribute to efficiency, depth and variety of teaching and learning processes.

According to Arop, Umanah and Effiong (2015), TLSMs are highly important for teaching especially for inexperienced teachers. The teachers rely on instructional materials in every aspect of teaching (Crist, 2014). They need materials for background information on the subjects they are teaching (Babajide, 2010). Moreover, teachers find it difficult to express themselves when they enter the classroom. Therefore, they need instructional materials to help them. Teachers often use instructional materials for lesson planning whereby these materials are also needed by teachers to assess the knowledge of their students (Onuoha-Chediebere, 2016). Crist (2014) outlined that teachers often assess students by assigning tasks, creating projects and administering examinations; in these processes, instructional materials are essential for all the activities. The author added that teaching and learning materials can also help teachers create assignment and project ideas for students. Arop *et al*. (2015) asserted that teachers are required to use several different methods to assess their students in order to provide the most accurate assessments. An extension on their ideas, they opined that TLSMs often provide innovative and creative ways to assess students' performance in the classroom setting. Moreover, it is hard to imagine any teacher who is capable of teaching effectively without

accompaniment of instructional materials (Busljeta, 2013). In addition, any teacher who is deprived of instructional materials would most likely experience stress and anxiety on daily basis (Crist 2014).

Instructional materials are also designed to develop the learner to optimize his/her learning objectives in a learning situation. Instructional materials bring science to bear in the classroom, Offorma in Usman and Adewumi (2006) stated that successful implementation of any curriculum is fully dependent on the quality and quantity of instructional materials available to teachers and pupils for use in schools. According to Busljeta (2013), instructional materials stimulate learner's interest and help both the teacher and the learner to overcome physical limitation during presentation of the subject matter. Similarly, Eya (2004) supplemented that instructional materials enrich learning and make it more pleasurable as they help to check the teachers' knowledge and means of transmission. Hence, Eya (2004) echoed that instructional materials also give the teacher the air of guidance, coordination, supervision and more time for correction, brighten the classroom and bring variety into the class lessons. Usman (2002) explained that a teacher for instance, can explain and describe a pipette or burette but it is very hard to tell the students exactly what a pipette or burette looks like real object for clarity. The picture of a pipette or burette is an instructional material that would help the students to understand the lesson. Usman and Adewumi (2006) observed that instructional materials have been found to enhance the quality of the learning experiences in many ways such as improving multi-sensory and multi-image factors responsible for inability of teachers to improvise instructional materials for the teaching and learning of science.

2.2.4 Usage of TLSMs in Chemistry and Physics Classroom

Philip and Denwigwe (2017), stated that in Nigeria secondary schools, Chemistry and Physics teachers use TLSMs with the objectives of providing concrete background for conceptual thinking, attracting high degree of students' interest and concentration in class. Advantageously, TLSMs results in providing atmosphere necessary for developmental learning, and hence making the teaching and learning more permanent. According to Philip and Denwigwe (2017), these objectives offer realistic experiences to stimulate self-activity on the part of the learners. They further added that the learner who has access to media capable of presenting information can learn a concept without requiring the services of a teacher. Thus, in the same vein they emphasis that every instructional material should be well prepared and should be as real in usage as possible for the intended purposes. It should however, be noted that no matter how good an instructional material may be in terms of production, it requires the skill of the teacher to use it to make teaching and learning more effective, quicker and enjoyable (Manqele, 2012).

Onuoha-Chediebere (2016) emphasized that TLSMs is expected to transmit and disseminate information to learners in such a way that complex concepts will be modified into simple tasks. The author further states that TLSMs supplements rather than substitutes a lesson.

Furthermore, Manqele (2012), held that science teachers' usage of instructional materials when teaching is a pre-requisite for effective implementation of the Outcome-Based Education, and this was critical for effective teaching of grade 11

Chemistry and Physics, especially in the Kavango East Region. Moreover, this links directly to what has been reported earlier, that teachers need to be aware of what the children are expected to pay attention to during teaching, the intended usage of the teaching materials or object of learning, and what they are actually occupied with, the child's perspective in using those materials (Samuelsson & Carlsson 2008). Moreover, Hansson, Hansson, Juter and Redfors (2015) added that physics teaching is analysed in terms of the relations made between theoretical models and real life teaching objects. For instance, Lofgren, (2009), for example, stated that the particle model' is the basis of the agreed upon consensus science material, and can be built upon by teachers in the teaching about filters by communicating about invisible 'dirt particles using TLSMs. A subtle introduction of particle models materials in Chemistry and Physics would probably help the children both in understanding the investigated science processes, and in generating building blocks for future encounters with science and theoretical models (Areljung, 2016).

2.2.5 Teachers' Constrains in using TLSMs in Chemistry and Physics classroom

One of the challenges experienced by Grade 11 Chemistry and Physics teachers in Namibia is the scarcity of equipment, materials and science laboratory in schools. Nakanyala (2015) outlined that secondary school laboratories are poorly equipped with necessary materials for teaching of Chemistry and Physics which negatively impacts teaching using TLSMs. For instance, lack of adequate ICT equipment, laboratory apparatus and internet access are some of the key problems that schools specifically in rural areas are facing now (Chapelle, 2017). The results of a research conducted in Kenya revealed that though some schools have been provided with

computers, most are limited to one computer which is used for the office administration purposes only (Chapelle, 2017).

Tety (2016) added that one of the major challenges faced by teachers in state secondary schools in accessing instructional materials is inadequate and ill-timed funding by the government for the purchase of instructional materials and making them readily available. Furthermore, Tety (2016) stated that most state secondary schools depend to a large extent on the state for funding; these results in a few school being given little support in term of TLSMs by the state. Furthermore, Boakye and Ampiah (2017) reported that one of the challenges faced by most science teachers were non-availability of teaching and learning resources. They stated that more often, teachers tend to complain of not being given Chemistry and Physics TLSMs. According to the study conducted in Ghana by Adu-Gyamfi (2014), the science materials and equipment were said to be unavailable and where they were available, they were insufficient for effective and efficient science teaching and learning.

According to the Ghanaian Ministry of Education (MOE, 2012) another major challenge in science resources, materials and equipment was the absence of science laboratories in Ghanaian schools, especially at the Junior High School (JHS) level, despite the curriculum requirement for students to have laboratory practical experience.

Poor salary is also another challenge that teachers face. According to Tety (2016), teachers like most civil servants in Tanzania are poorly paid and this becomes a hindrance for them to purchase their own teaching materials or acquisition of new

ideas, skills and knowledge as they are unable to finance their further educational programmes including Information and Communication Technology (ICT) training. With this, the teaching capabilities of teachers and learners are constrained substantially during science classroom interaction (Onche, 2014).

According to Tety (2016) another challenge that teachers face in accessing instructional materials is lack of clear policy and monitoring mechanisms to ensure that enough funds are provided to community secondary schools for purchasing instructional materials and also these funds are used for the intended purpose. As Onche (2014) stated, government's policy towards efficient provision of TLSMs has not been encouraging and has always not been well planned, monitored, supervised and evaluated with rural schools as the back bench of implication of these policies.

The report of a research conducted in Malaysia–showed that the overall key issues and challenges found to be significant in using TLSMs by Physical Science teachers are lack of effective pre-service and in-service Chemistry and Physics teachers training on usage of science apparatus and materials in most secondary schools (Simin, Thanusha, Logeswary & Annreetha, 2016). Therefore, teachers' readiness and skills in using TLSMs are playing essential role in the use of teaching and learning resources in science education (Ghavifekr & Rosdy, 2015). Furthermore, teachers need sufficient skills to implement the materials usage and to have high confident level to use them in a classroom setting. Thus, teachers require insight into the pedagogical role of TLSMs in order to use it meaningfully in their teaching processes.

Moreover, Boakye and Ampiah (2017) asserted that time management was a problem for newly appointed teachers as they find it difficult to cope with time management leading to ineffective teaching and learning process, and hence the use of TLSMs.

Teachers' improvisations are also another constrain faced by some science teachers. According to Nyawira (2015), there are locally available materials that a science teacher may use as concrete objects or teaching aids to help students understand scientific concepts. These include coins, playing cards, students' shoes, school's tank, money, dice, flag post, strings, match sticks, marbles, cans and many others. These are materials which can make possible interventions to inadequacy of instructional resources in schools. According to Namtwi (2018), improvisation is the use of material, which is readily available in the environment in place of the original materials, which are not available or are expensive, delicate or sophisticated, to bring about the same learning effect. Improvisation means using whatever is available because one does not have what is really needed (Namtwi, 2018). Improvisation is one option for ensuring effective teaching and learning. For example, Aina (2012) believes that teachers must utilize discarded resources around them to improvised teaching aids for Physics. Furthermore, Aina (2012) stated that in Africa, it is difficult to obtain conventional TLSMs because unavailability of funds has made the cost of the materials unaffordable. It is therefore imperative for teachers to look for other means of providing the needed TLSMs by improvising to cope with the demands of teaching and learning.

Adu-Gyamfi, (2014), in his research revealed that one of the challenges of teaching science was the students' attitude toward science. According to the author, students perceived sciences as difficult subjects compared to the other subjects. Adu-Gyamfi, (2014) further outlined that the students' perceived difficult nature of science stems from the fact that the language of science was at times uncommon in everyday life than the other subjects they learn in school. The researcher continued that; the content of science is too broad as compared to other subjects; students spent a lot of time to cover science content in preparation towards examinations; and science questions were loaded compared to other subjects from examination council (Adu-Gyamfi, 2014). In such cases, students found it difficult to respond to revision exercises and hardly asked questions but could only answer when they make reference to their science materials.

2.2.6 Teachers' views on the use of TLSMs in teaching

The use of TLSMs helps to facilitate effective teaching of science subjects as the teaching materials help to gain learners' attention and maintains their interest so that they can acquire and master the appropriate skills (Krishnasamy, Veloo & Hooi, 2013). Additionally, the authors stressed that teachers need to sacrifice more time in teaching using TLSMs in science subjects, which if appropriately utilized, could facilitate effective teaching of Chemistry and Physics in the classroom.

According to Mahadi and Shahrill (2014), textbook is one of the important resources in the process of teaching and learning. In their views, the textbook is an instrument perfectly adaptable to every individual's own pace, and with the aid of the textbooks,

the student recapitulates, assimilates and further internalizes what was learnt in class. Textbook as TLSMs can also provoke questions and induce students to supplement the information it contains (Oliveira & Gilbert, 2014). Moreover, a good textbook encourages students to think and stimulates critical reflection. Teachers view textbooks as key TLSMs because it is a dominant form of curriculum material and is the key classroom teaching aid or TLSMs in schools (Yong, 2010). Yong (2010) further stressed that the power and influence of the textbook lies within the printed words and that it is the key element in the educational process. The textbook is the tool for instruction and its potentials, limitations and actual use are conditioned by features of the total system (Wahid & Shahrill, 2014). Thus, textbooks and other TLSMs without doubt carry intrinsic values and the historical mirror on which the nation wishes to see it reflected. Oliveira and Gilbert (2014) held that even with the latest advancements in teaching resources such as e-textbooks, teachers still need to scaffold the entirety of the classroom learning effectively to their students. In these way, students were also encouraged to be reflective in the best use of primary sources (for example, the internet archives or the commercially available learning packages) in order to engage students in science classes.

In a study on teachers' views about digital educational tools used in teaching, Celik and Aytin (2014) reported that digital tools motivated students and improved their skills by making them eager to learn new concepts. However, teachers need to have the required pedagogical approaches and skills to integrate technology into their lessons (Basal, 2016). It was also highlighted that using technology in teaching has become more important today because teachers need to keep pace with students' knowledge of technology (Richards, 2014). Furthermore, designing and developing

interactive materials with new technologies and organizing resources for teaching are elaborate skills for teachers (Basal, 2016). In another report, Yordming (2017) noted that teachers regarded technology as offering many options in making teaching interesting and more productive in terms of content development. Furthermore, Yordming (2017) stated that creating digital teaching materials require a different approach and skills. According to Basal (2016), teachers viewed their training programs as inadequate in equipping them with the knowledge and ability to integrate technology effectively with their teaching methods. Furthermore, Basal (2016) reported that well-planned activities for designing and developing digital materials contributed positively to teachers' attitudes toward technology, noting that a statistically meaningful difference was detected between teachers' attitudes toward Web 2.0 tools introduced in practice in line with the study. Thus, practical training for developing digital materials contributed to teachers' integrating technology effectively with their lessons. It was emphasized that integration of both pre-service and in-service applied technology training into teaching practice significantly helped teachers to adopt technological approaches (Basal, 2016).

According to Yalın (2010), science teachers' view that, using teaching material like Tablet Personal Computers (TPCs) can cause more fun with visuals and animations and students' interest can increase in science and technology courses. However, the most disadvantages of TPCs usage in teaching include reduced social interaction among the students, and the adverse effect of TPCs' radiation emission on eyes' health. However, the studies conducted with TPCs revealed that they increase the interest of students in learning, provide motivation for the course, and enable teachers to teach the science subjects more effectively (Maccabe, 2011).

As a result of the study on use of computer and technology as teaching aids or TLSMs, the teachers' views revealed that computer and technology helped to attract students' attention on the concepts presented in the class, improve students' understanding, and helped the teachers to explain the subject in an effective way (Yaman, 2018). The British Educational Communications and Technology Agency (BECTA) (2010) stated that concept maps and flow charts could be used to teach abstract concepts in a better way and to make connections between the subjects, noting that concept maps and flow charts are practiced more easily by using teaching materials. Moreover, Havlik (2014) stated that teachers' views on the use of TPCs give an opportunity for the students to develop positive attitudes towards the science course and receive an effective teaching support. In a similar study, Yalın (2010) stated that tablet enriched the students' learning environment and the students benefited from archive notes and the interpretations of the teacher with the use of TPCs. Yalın (2010) also stated that the use of technology motivates the students to learn, stressing that the use of wireless and technological devices in the class environment had a lot of advantages. According to Enriquez (2010), some of the advantages of using TPCs in teaching and learning include making meaningful and immediate evaluations about student learning, helping student maximizes learning, and giving required feedback to learners.

2.2.7 Strategies to improve teachers' use of TLSMs for effective teaching

Holubova (2008) stated that effective teaching methods are characterized by a shift from whole-class to small group instruction, by a shift from lecture and recitation to coaching, by a shift from competitive to a cooperative social structure, and by a shift

from all students learning the same thing to different students learning different things. In this regard, improvisation can be used by teachers as one of the strategies which could improve the use of TLSMs for effective teaching. Improvisation, as defined by Nkechi and DomNwachukwu (2006) is the use of alternative materials and resources to facilitate instruction when there is a lack or shortage of some specific teaching aids. Improvisation helps teachers to learn to design and construct materials/resources that would enhance their functions in the absence of the regular materials which can contribute to effective teaching (Nkechi & DomNwachukwu, 2006). According to Sandifer and Haines (2009), teacher's use of hands-on activities using created materials are the best strategy for effective science teaching and learning.

On the other hand, an intervention of Project Based Learning (PBL) can also be used by teachers to improve their teaching of Chemistry and Physics (Kokotsaki, Menzies & Wiggins, 2016). One of the most important scientific practices that the PBL units emphasize is having learners construct TLSMs and connect them with evidence-based explanations during classroom teaching (Halubova, 2007). However, Halubova, (2007), stated that, for these to happen, science teacher should first be trained on how the whole process of PBL works. Here, PBL directs the involvement of learners in making TLSMs which is not an isolated task, and activates their interest to learning Chemistry and Physics (Prince & Felder, 2007). They added that raising the importance of the usage of TLSMs during Physics teaching is a key scientific practice which intends to provide learners with scientific skills on usage of materials and make them to become directly involved in the teaching process, which facilitates effective teaching. Furthermore, by incorporating the use of learners-made

materials into teaching afford learners the opportunity to learn how to use materials to explain and predict the scientific ideas in a consistent and logical manner which help learners to understand their science subject contents (Halubova, 2007). Halubova (2007), maintained that, the use of a set of materials builds and tests learners' practical skills in Chemistry and Physics.

Prince and Felder (2007) explained that; to help in-service teachers, the best way to do it is to prepare projects that can be used at all school levels and these projects contain an instructional manual, the overview of the physical background of the problem, students activities, experiments, learning resources, worksheets and evaluation thereof. Prince and Felder (2007) added that examples should be given to integrate the project into the educational program and an overview of the final competencies stated including TLSMs to be used. These can only be done by organizing workshops or seminars for in-service teachers to strengthen collaboration, in which a continual feedback and assessment under professional development opportunities for teachers are created. These will improve the quality of science instructional materials and create higher standards for science education; and the use of TLSMs for effective teaching can be realized.

Furthermore, Holubova (2008) suggested some of the teaching method to be used to achieve effective teaching as: problem-based learning, project-based learning, e-learning techniques, and motivation by adventure in pedagogy, computer-based instruction and experiments. Moreover, Prince and Felder (2007), singled out that one of the best teaching methods is project-based learning, noting that giving students' freedom to make materials for learning is critical to their construction of

knowledge while using TLSMs. Project-based learning also places students in realistic and contextualized problem-solving environments using teaching resources in the classroom and can serve to build bridges between phenomena in the classroom and real-life experiences (Halubova, 2007). He further emphasized that teachers should be trained on how to use such method and deliver the contents to learners effectively.

According to Wu and Foos (2010), presentation is another heart of the teaching process, and the best way of getting students excited in Chemistry and Physics is by allowing them to touch and use the materials through guidance and supervision. In addition, science teachers should be trained on the usage of TLSMs in order to use a variety combination of teaching methods with materials to be used by both learners and teachers like boards and audio-visual aids resources such as test-tube, ammeter, voltmeter and practical videos (Wu & Foos, 2010),. These makes Chemistry and Physics more alive and real to the students as our millennium students are mostly hands-on and visual learners due to the image-centric, visual world in which they are raised (Wu & Foos, 2010). Moreover, training teachers on the usage of TLSMs can help learners to grasp the concepts better as they can picture them like in recent laboratory materials using thermometer in laboratory activity in Chemistry to measure temperature. Also, the use model of solar system showing planets in model in Physics which can contribute to improvement in usage of TLSMs for effective teaching and learning of science concepts (Wu & Foos, 2010).

2.3 Theoretical framework

Several theories have been used by different researchers to examine the use of TLSMs for effective teaching (Abaidoo, 2018). This study is guided by social constructivism, cognitive constructivism, and behaviourism theories. These three theories are relevant to the study, and therefore, the researcher used all of them under this framework.

According to Akpan, Igwe, Blessing, Mpamah and Okoro (2020), the constructivism theory holds that learning is significant when learners through active participation, construct or create basic knowledge by themselves through enquiry and discovery. Akpan et al., (2020) further emphasized that these can be done while looking at the theory of constructivism with the focus on social constructivism as interaction, collaboration and group work for effective learning. Constructivism theory was propounded by Jerome Bruner in 1966 (Olorode and Jimoh, 2016) and the theory states that people construct their own understanding and knowledge of the world, through individual experiences and by reflecting on those experiences. Likewise, Akpan et al. (2020) postulate that constructivism is an epistemological commitment and instructional model which includes aspects of Piagetian, Ausubelian and Vygotskian learning theories; namely, the importance of ascertaining prior knowledge or existing cognitive frameworks, as well as the use of relevant information to drive conceptual change.

Social constructivism is a variety of cognitive constructivism that emphasizes the collaborative nature of much learning (Vygotsky, 1978: 57). Vygotsky was a

cognitivist, but rejected the assumption made by cognitivists such as Piaget and Perry that it was possible to separate learning from its social context. He argued that all cognitive functions originate in, and must therefore be explained as products of social interactions and that learning was not simply the assimilation and accommodation of new knowledge by learners; it was the process by which learners were integrated into a knowledge community (KC).

Social constructivism is a collaborative form of learning based on interaction, discussion and knowledge sharing among students, thus the teacher's role is to employ teaching methods that are learner-centred and collaborative in nature (Akpan et al. 2020). Furthermore, social constructivism posits that learner's construction of knowledge is the product of social interaction, interpretation and understanding (Vygotsky, 1962). As the creation of knowledge cannot be separated from the social environment in which it is formed, learning is viewed as a process of active knowledge construction within and from social forms and processes (Adams, 2006). In social constructivism, children's understanding is shaped not only through adaptive encounters with the physical world but through interactions between people in relation to the world that is not merely physical and apprehended by the senses, but cultural, meaningful, and significant (Akpan et al. 2020). Also, Abaidoo (2018) argued that individual's ability to learn and think begin from their social interaction necessary for cognitive development. Akpan et al. (2020) see learning as a social activity associated with other human beings like the peers, family members as well as casual acquaintances, including the people that existed before and recognizes the social aspect of learning.

Vygotsky (1978) believed that life long process of development is dependent on social interaction and that social learning actually leads to cognitive development. In other words, all learning tasks (irrespective of the level of difficulty), can be performed by learners under adult guidance or with peer collaboration. This theory helps to give a backup to the establishment of opportunities for students to collaborate with the teacher and peers in constructing knowledge and understanding, which can effectively be achieved through appropriate use of relevant TLSMs during Chemistry and Physics teaching and learning. Kapur (2018), observed that social construction of knowledge takes place in various ways and at different locations. He further explained that it could be achieved through group discussion, teamwork or any instructional interaction in an educational or training institution, social media forum, religious and market places. As students interact with people, the material and immaterial environment, they gain understanding and gather experience which is needed to live successful and functional lives (Dorgus, 2015). The theory of social constructivism is applicable to this study as the learners would construct new knowledge as they are using TLSMs, interact with one another during the usage of TLSMs, accommodates the views of other and will be motivated as they are using TLSMs under the teachers' guidance and monitoring in Chemistry and Physics classroom.

Thus, the usage of TLSMs in Chemistry and Physics by teachers provides new opportunities for learners to learn actively in a socially scientific manner. These provide the atmosphere for Chemistry and Physics teachers to engage their learners actively by using TLSMs effectively in teaching Chemistry and Physics. Hence, this theoretical framework was used by the researcher to study how Chemistry and

Physics teachers use different TLSMs for effective teaching of grade 11 Chemistry and Physics in the Kavango East Region.

Furthermore, Dee (2013) behaviourism equates learning with changes in either the form or frequency of observable performance. He further stressed that learning is accomplished when a proper response is demonstrated following the presentation of a specific environmental stimulus. For example, when presented with a scientific flashcard, it makes learners to develop scientific presentation and respond according to the situation. Behaviourism focuses on the importance of the consequences of those performances and contends that responses that are followed by reinforcement are more likely to recur in the future. No attempt is made to determine the structure of a student's knowledge or to assess which mental processes it is necessary for them to use (Winn, 1990). The learners are characterized as being reactive to conditions in the environment as opposed to taking an active role in discovering the environment interactions (Dee, 2013). Moreover, behaviourists assess the learners to determine at what point to begin instruction as well as to determine which reinforcers are most effective for a particular student, he added. These Dee's prescriptions have generally been proven reliable and effective in facilitating learning that involves discriminations (recalling facts), generalizations (defining and illustrating concepts), associations (applying explanations), and chaining (automatically performing a specified procedure). According to Dee (2013), behaviourism was used as the basis for designing many of the early audio-visual materials and gave rise to many related teaching strategies, such as Skinner's teaching machines and programmed texts. In addition Dee (2013) gave more recent examples which include principles utilized within Computer-Assisted Instruction (CAI) and mastery learning. Therefore,

instruction is structured around the presentation of the target stimulus and the provision of opportunities for the learner to practice making the proper response. Therefore, the theory fits in the study as teachers' uses of TLSMs for effective teaching of grade 11 Chemistry and Physics is aimed at stimulating learners' consciousness to enhance assimilation and long term memory of concepts taught.

On the other hand, in the late 1950s, learning theory began to make a shift away from the use of behavioural models to an approach that relied on learning theories and models from the cognitive sciences (Dee, 2013). Psychologists and educators began to de-emphasize a concern with overt, observable behaviour and stressed instead more complex cognitive processes such as thinking, problem solving, language, concept formation and information processing (Snelbecker, 1983). In addition, Merrill, Wardell and Read (2014), claim that this shift from a behavioural orientation (where the emphasis is on promoting a student's overt performance by the manipulation of stimulus material) to a cognitive orientation (where the emphasis is on promoting mental processing) has created a similar shift from procedures for manipulating the materials. The theory is vital in the sense that through the use of TLSMs (for example, in Grade 11 Chemistry and Physics), teachers are likely to use materials that stimulate learners' mental reasoning as they are manipulating a variety of teaching and learning resources (Karagiorgi & Symeou, 2005), Cognitive theories stress the acquisition of knowledge and internal mental structures and focus on the conceptualization of students' learning processes and address the issues of how information is received, organized, stored, and retrieved by the mind (Dee, 2013).

Moreover, Dee (2013) stated that instructional explanations, demonstrations, illustrative examples, and matched non-examples are all considered to be instrumental in guiding students' learning. In the same vein, the use of TLSMs by Grade 11 Chemistry and Physics teachers also requires well planned procedures and guidelines on carrying out experiment by the teachers with their learners in order to achieve effective teaching through understanding. Additionally, the way that learners attend to learning tasks, code, transform, rehearse, store and retrieve information and their thoughts, beliefs, attitudes, and values are also considered to be influenced by the TLSMs used in the teaching and learning process (Winne, 1985). According to Merrill et al (2014), the real focus of the cognitive approach is on changing the learner by encouraging him/her to use appropriate learning strategies. Specific instructional or real-world events will trigger responses, but the learner must believe that the knowledge is useful in a given situation before he or she will activate it (Dee, 2013). Dee (2013) emphasised that, instruction must be based on a student's existing mental structures, or schema, to be effective. That is, it should organize information in such a manner that learners are able to connect new information with existing knowledge in some meaningful way as they are using TLSMs in Grade 11 Chemistry and Physics for teaching to be effective. For example, instructional materials like textbooks frequently draw an analogy between the familiar architect's profession and the unfamiliar instructional material profession to help the novice learner conceptualize, organize, and retain the major duties and functions of an instructional designer (Reigeluth, 2013).

2.4 Summary

This chapter presents the review of the literature relevant to this study. The literature reviewed were based on the concept of TLSMs, types of TLSMs used by Chemistry and Physics teachers, ways in which Chemistry and Physics teachers made use of different TLSMs. Furthermore, factors that constrain Chemistry and Physics teachers from using different TLSMs, views of Chemistry and Physics teachers on the use of different TLSMs, and the strategies used to support Chemistry and Physics teachers to improve their uses of TLSMs for effective teaching of Chemistry and Physics contents. Lastly, the chapter presents the theoretical framework which guided this study.

The next chapter presents research on the methodology employed in this study.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

The main goal of this study was to investigate teachers' use of TLSMs for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region, Namibia. This chapter thus describes the methodological framework that was used to execute study. The chapter describes the research design, the study population, sample and sampling, research instruments and data collection procedure. Additionally, the data analysis method and research ethics employed are discussed.

3.2 Research design and method

According to Maree (2015), research design is a plan or strategy which involves the underlying philosophical assumptions to specifying the selection of respondents, data gathering techniques to be used, and the data analysis to be done. Additionally, a research design is a type of inquiry within the qualitative, quantitative, and mixed methods approaches that provide specific direction for procedures in a research (Creswell, 2014). The design plays an essential role in an investigative study, because it provides an outline of the route to be followed in order to conduct the study (Creswell and Clark, 2007).

This study used the sequential explanatory mixed methods research design to investigate the research problem. This design involves collecting and analyzing

quantitative and then qualitative data in two consecutive phases within one study (Nataliya, Ivankova & Creswell, 2006).

In sequential explanatory mixed methods design, the quantitative phase (numbers) is followed by the qualitative phase (personal experiences) (Creswell, 2013); where the qualitative findings are used to deepen the findings from the quantitative approach (Bowen, Rose & Pilkingston, 2017). Thus, after the structured quantitative survey, the study continues with a qualitative approach, this time trying to understand the reasons for the initial responses.

Maree (2015) outlined the sequential flow of the quantitative and qualitative phases in the visual diagram of the design as shown below:

Figure 4. Sequential explanatory mixed methods design (Maree, 2015)

Therefore, the sequential explanatory mixed research approach provides some significant opportunities to gain a deeper understanding of on how Chemistry and Physics teachers make use of TLSMs in order to effectively teach Grade 11 Chemistry and Physics in the study area.

The quantitative research approach using questionnaires was employed to collect data on the ways teachers' uses TLSMs for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region, Namibia. On the other hand, the qualitative research approach using interview was employed to collect data on the factors constraining Chemistry and Physics teachers from using TLSMs and views of the Chemistry and Physics teachers about using TLSMs. Lastly data were collected on the strategies that could be used to support Chemistry and Physics teachers to improve the use of TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region.

3.3 Population of the study

The study population included all Chemistry and Physics teachers teaching in senior secondary schools, and one SEO in the Kavango East Region. According to the information obtained from the Kavango East Regional Directorate of Education, Arts and Culture (KERDEAC), there are combined 21 Chemistry and Physics teachers teaching in 18 Senior Secondary Schools offering the subject in the region. In addition, there was only one SEO in the region. Thus, the total population sampling method was used to select the sample.

3.4 Sample and sampling procedure

The total population sampling technique was used to select all the 21 Grade 11 Chemistry and Physics teachers teaching in senior secondary schools, and one SEO in the Kavango East Region. The total population sampling is a sampling method

which is selected to provide a diverse range of cases relevant to a particular study (Barau, 2013). Thus, the study sample consisted of 22 participants. To form part of the sample, a participant must be:

1. A Grade 11 Physics teacher currently teaching in the Kavango East Region,
2. A Grade 11 Chemistry teacher currently teaching in Kavango East Region, and
3. A SEO currently working as subject adviser (SA) in the Kavango East Region.

All the 22 participants identified with pseudonyms (Table 1) completed the questionnaires after which a sub-sample of 10 Grade 11 Chemistry and Physics teachers and the 1 SEO were purposively selected to participate in the follow up interviews and classroom observations.

Table 1. Pseudo names of the study participants (schools, Grade 11 Chemistry and Physics teachers and Science Education Officer (SEO)

Number of schools	Name of schools / Sites	Number of Grade 11 Chemistry and Physics teachers per school	Pseudo name of teachers/ participants per school
	School A	1	Teacher A_1
	School B	1	Teacher B_1
	School C	1	Teacher C_1
	School D	1	Teacher D_1
	School E	1	Teacher E_1
	School F	1	Teacher F_1
	School G	1	Teacher G_1
	School H	1	Teacher H_1
	School I	1	Teacher I_1
	School J	2	Teacher J_1
			Teacher J_2
	School K	1	Teacher K_1
	School L	1	Teacher L_1
	School M	2	Teacher M_1
			Teacher M_2
	School N	1	Teacher N_1

School O	1	Teacher O_1
School P	2	Teacher P_1
		Teacher P_2
School Q	1	Teacher Q_1
School R	1	Teacher R_1
Region Office	1	$Officer_1$

3.5 Research instrument

Closed-ended survey questionnaires, face-face interviews, and classroom observation to collect data on the research questions.

3.5.1 Closed-ended survey Questionnaires

A closed-ended survey questionnaire is "self-report data collections instrument that research participants fill out as part of a research study" (Johnson & Christensen, 2012). The Likert scale closed-ended survey questionnaires (appendix 9&10) were developed by the researchers which were used to gather data on the ways that Chemistry and Physics teachers use TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area. The questionnaire consisted of two sections, Section A and Section B. Section A of the questionnaire was about; Biographical Information and Section B was about; Teachers made use of TLSMs for effective teaching of Grade 11 Chemistry and Physics. The questionnaires were designed based on four-point Likert scale (A-Agree, SA-Strongly Agree, D-Disagree and SD-Strongly Disagree) to survey the ways the participants use TLSMs for effective teaching of Grade 11 Chemistry and Physics.

3.5.2 Semi-structured face-to-face interviews

An interview is a conversation between two people (the interviewer and the interviewee) where questions are posed by an interviewer to obtain information from the interviewee to get more information concerning the particular issue (Tety, 2016). According to Barua (2013), a semi-structured face-to-face interview is a kind of formalised structured interview conducted by researchers who use interview protocols for face-to-face interview and responses from participants maybe recorded. The semi-structured face-to-face interviews (appendix 11&12) to gather data on the factors constraining Chemistry and Physics teachers from using TLSMs to effectively teach Grade 11 Chemistry and Physics, the views of Chemistry and Physics teachers about using TLSMs for effective teaching of Grade 11 Chemistry and Physics, and the strategies that could be used to support Chemistry and Physics teachers to improve the use of TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area.

3.5.3 Live Classroom Observation

Live classroom observation (appendix 13) to gain deeper insight and understanding of the Chemistry and Physics teachers' responses provided in the survey questionnaires and structured face-to-face interviews. Maree (2015) defines observation as the systematic process of recording the behavioural patterns of participants, objects and occurrences without necessarily questioning or communicating with them. Moreover, live classroom observation is an act of watching a teacher's performance in a classroom or learning environment and

recording them where possible to collect quantitative data (Barua, 2013). In addition, observation refers to the careful watching of behavioural patterns of people in certain situations to obtain information about the phenomena of interest (Johnson and Christensen, 2012).

3.6 Data collection procedure

The closed-ended survey questionnaires were administered by the researcher to all the twenty-one (21) Grade 11 Chemistry and Physics teachers and the one (1) SEO in the Kavango East Region. The participants were given one week to complete the questionnaires and the researcher personally collected the completed questionnaires from them after the one week. After preliminary analysis of the questionnaire data, the researcher carried out a face-to-face interview with the sub-sampled 10 Grade 11 Chemistry and Physics teachers and 1 SEO. The face-to-face interview was recorded using an audio recorder. During each interview session, a social distance of 1.5m was maintained between the interviewer and interviewee in line with the coronavirus disease (COVID-19) mitigation measures imposed by the Government of the Republic of Namibia. Each interview session lasted for approximately 30 minutes. All the recorded interviews were transcribed into text and were further analyzed into themes. Thereafter, live classroom observation was conducted to further deepen the data collected to answer the research questions. The researcher went into the classroom with observation checklist where the pre-determined statements to be used during live classroom observation was printed, and an extra notebook. The researcher marked cross (x) next to statement which was not observed and marked tick (√) next to statement which was observed during the classroom observation.

3.7 Pilot study

Prior to the main study, the researcher piloted the instrument using three Grade 11 Chemistry and Physics teachers at the two schools in the Kavango West Region. These schools are not part of the main study. Maree (2015) explained that a pilot study involves working with a small group of people similar to the main study sample, and is carried out before the main study is conducted with the ultimate goal of testing whether the participants respond to the questions correctly and whether the responses provided for the questions are suitable. This enables the researcher to adjust the instrument as far as the feedback dictate. After the pilot study, the closed-ended survey questionnaire and observation checklist were not changed as they were found to be relevant and responded to the questions of the research. However, items numbers 2, 7, and 9 of the interview questions for Chemistry and Physics teachers were slightly adjusted by adding "Explain your answer" as these were initially "yes or no" questions. In the same vein, question number 17 sounded like it was a follow-up question for question 16 and the participants felt that it was supposed to be part of question 16, instead of standing alone. Thus, question 16 was merged with question 17 in the revised interview guide. Initially, setting up time and date for face-to-face interview and classroom observation did not go well as planned as teachers were afraid of COVID-19 pandemic due to rising infection cases and deaths in the Kavango East Region. Another challenge encountered during the pilot study was that teachers were busy with syllabus completion for Grade 11 Chemistry and Physics as well Grade 12 Advanced Subsidiary Level. Thus, the researcher consulted and set up dates that are most convenient for the participants until the pilot study was completed.

Similar consultations and setting up of different dates were explored during the main study and that made the data collection successful while observing the COVID-19 mitigation measures in schools. Such measures include correct wearing of face masks, maintaining social distance of 1.5m apart, and frequent hand sanitation.

3.8 Validity and reliability of the research instrument

These sections present the validity and reliability of the research search instrument which guided the study in collecting data to answer the research questions.

3.8.1 Validity of research instrument

The validity of the study was ensured by using different instruments (triangulation) to investigate the research problem. According to Maree (2015), validity of a study is enhanced through the use of different instruments (triangulation) such as questionnaire, interviews, and field observation. Cohen, Manion and Morrison (2018) added that triangulation enables the researcher to compare many sources of evidence in order to determine the accuracy of information or data collected in a study. It is essentially a means of cross-checking data to establish their validity.

Therefore, the researcher ensured validity by first submitting the research instruments to the supervisors for content validation and approval of the instruments. Furthermore, the researcher through the supervisor submitted instruments to other

specialist at University of Namibia (UNAM) for content and face validations before the instruments were used in the study to collect data on the research problem.

To improve the validity of the research instruments (questionnaires, interview guide and observation checklist), the researcher first carried out a pilot study by administering the instruments to two Grade 11 Chemistry and Physics teachers at two different schools that are not part of the main study. The aim of the pilot study was to check the appropriateness and suitability of the instruments' protocols in order to maintain consistency and transparency (Newman, Lim, & Pineda, 2013). The feedbacks received were used to adjust the instruments (as described under the pilot study) before being used in the main study. According to Le Grange (2014), validity of an instrument is used to assess the extent to which a research instrument accurately measures the phenomenon that it is intended to measure. In other words, validity of an instrument is the extent to which an instrument measures what it purports to measure (Bolarinwa, 2015).

3.8.2 Reliability of Research Instruments

According to Bolarinwa (2015), reliability of research instrument is the extent to which the instrument yields the same results over repeated or multiple trials. It refers to whether scores to items on an instrument are internally steady, stable over time and whether there was consistency in test administration and scoring (Creswell, 2014).

Reliability of the study was achieved through test-retest method where participants from the school which participated in the pilot study completed the questionnaire and also took part in the face-to-face structured interview. The procedure was repeated after two weeks at the same school. Data was then gathered from the two pilot studies and the research used a spearman rank-order correlation to establish the correlation coefficient. A Cronbach's alpha was used to check for consistency in each research question to determine reliability. Each research question gave the following results after the internal consistence test and this was done using excel.

1. In what ways do Chemistry and Physics teachers make use of different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?
   - **Items = 13, α = 0.721**
2. What factors constrain Chemistry and Physics teachers from using different TLSMs to effectively teach Grade 11 Chemistry and Physics contents in the Kavango East Region?
   - **Items = 11, α = 0.745**
3. What are the views of the Chemistry and Physics teachers, and Science Education Officer (SEO) on the use of different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?
   - **Items = 9, α = 0.780**
4. How can the Chemistry and Physics teachers be supported to improve their uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?
   - **Items = 10, α = 0.761**

The results above shows that the internal consistence test performed on the research questions gave a Cronbach's Alpha greater than 0.70 for all the research questions. According to Creswell and Clark (2018) a study should thrive to achieve an internal consistence of greater than 0.65. Therefore, the study satisfied with the internal consistence reliability for every research question and the instrument was considered reliable.

3.9 Data analysis

Descriptive statistics (percentage and frequency distribution) were used to analyze the quantitative data and then presented in tables. On the other hand, thematic analysis method was used to analyze the qualitative data whereby, the data were grouped into themes that emerged based on the research questions. First, the recorded interviews were transcribed verbatim and coded. According to Maree (2015), coding is the process of reading carefully through your transcribed data, line by line, and dividing it into meaningful analytic units, and marking the segment of data with symbols, descriptive words or unique identifying names. Finally, the coded data were organized into themes based on the research questions and discussed in details.

3.10 Research Ethics

After obtaining the research ethical clearance certificate from the University of Namibia's research ethics committee, the researcher sought and obtained written permission from the Executive Director of the Ministry of Education Arts and

Culture and the Kavango East Regional Director of Education, Arts and Culture to carry out the study in the region. Furthermore, the researcher sought and obtained written permission from the principals of the schools where the participants are located before meeting the participants (Chemistry and Physics teachers). The researcher informed the participants about the purpose of the research and their anonymity were assured by using pseudo names. The participants were informed that their participation in the study was voluntary and they were assured of their right to freely withdraw from the study if they wanted to do so at any time without any consequences. Finally, soft copies of the collected data were stored in password protected folders in both Universal Storage Bus (USB) device and personal computer while hard copies of the data were filed and stored in a lockable cupboard to prevent unauthorised access. The data will be kept for a period of 3 years and then deleted/destroyed permanently.

3.11 Summary

This chapter described the research designs, study population, sample and sampling, research instruments and data collection procedures. The chapter also described the pilot of the study, validity and reliability, data analysis methods used, and the research ethical considerations.

The next chapter presents the research results and discussions which are based on the findings from the questionnaires, structured face-to-face interviews and classroom observations.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This chapter presents the demographic information of the study participants as well as the findings and discussion on the investigation of teachers' use of Teaching and Learning Support Materials (TLSMs) for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region, Namibia. The results were obtained using closed-ended survey questionnaires, face-to-face structured interviews, and live classroom observations, and addressed the four research questions.

Thus, the results and discussion were presented in sections and sub-sections based on these research questions as the main themes.

4.2 Demographic Information

The demographic information of the study participants (comprising of twenty-one Chemistry and Physics teachers and one SEO) are presented in Table 2 below.

Table 2: Demographic characteristics of the participants (Chemistry and Physics teachers = 21; SEO = 1)

Variable	Categories	Counts	Percentages
Gender	Male	16	76.1
	Female	5	22.7
SEO	Male	1	100
Age in years	20-29	5	22.7
	30-39	15	68.2
	40-49	1	4.5
SEO	50+	1	100
Highest qualifications	Doctor of Philosophy (PhD)	0	0
	Master of Education (M.Ed)	2	9.5

	Bachelor of Education Honours (B.Ed Hon)	13	54.4
	Bachelors of Science (B.Sc)	1	4.5
	Mathematics and Science Teachers Education Programme (MASTEP)	2	9.1
	Basic Education Teachers Diploma (BETD)	2	9.1
	Postgraduate Diploma in Education (PGDE)	1	4.5
SEO	Master of Education (M.Ed.)	1	100
Years of teaching experience	1-5	21	95.5
	6-10	0	0
	11-15	0	0
	16-20	0	0
	21+	0	0
SEO	11-15	1	100
Years in which highest qualification obtained.	Before 1989	0	0
	1990-2000	0	0
	2001-2010	3	13.6
	2011 +	18	85.7
SEO	2011+	1	100

Table 2 shows that most of the Chemistry and Physics teachers who participated in this study were male (76.1%) while only a few were females (22.7%). This is because male teachers dominate the teaching of Chemistry and Physics in the Kavango East Region – the study area. The table further shows that the majority (68.2%) of the teachers were in the age range of 30-39 years. Thus, most of the Chemistry and Physics teachers in the Kavango East Region are in the youth age bracket. This indicates that the region has active and energetic teachers in the field of Chemistry and Physics with Masters and Bachelor of Education Honours Degrees. The findings also show that all the teachers who participated in the study had a variety of teaching qualifications but the majority (54.4%) of them had the Bachelor of Education (Honours) degree in their subjects. This shows that the Chemistry and Physics teachers who participated in the study were well qualified to teach these subjects in the study area. Therefore, this corroborate the findings by Harris (2011) where it was established that educational qualification of science teachers was not really a factor to the challenges that Chemistry and Physics teachers faced in the

study area. The results showed that Kavango East Region has recent graduates who are currently teaching Chemistry and Physics in Senior Secondary Schools in the region. Table 2 also showed that all the 21 teachers who participated in the study had 1-5 years of teaching experience. These findings indicated that the participants had fewer years of teaching experience, and this might negatively affect their usage of TLSMs for effective teachings of Grade 11 Chemistry and Physics. Ceka and Murati (2016), highlighted that the experience of teachers is crucial in developing and using relevant TLSMs for teaching effectiveness, emphasising that more skills are acquired as the teacher gains more years of experience. In addition, Hill's (2014) suggested that schools need teachers with many years of teaching experience in the field to effectively teach the subject contents. Advantageously, the SEO in the Kavango East Region had a vast advisory service experience (11 to 15 years) in the science streams which include Grade 11 Chemistry and Physics. Therefore, he might provide helpful advices to the less experienced Chemistry and Physics teachers in Kavango East Region in terms of identifying and developing relevant TLSMs and using them for effective teaching of Chemistry and Physics in the area.

4.3: Research Question One

In what ways do Chemistry and Physics teachers make use of different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?
In what ways do Chemistry and Physics teachers make use of different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?

In answering this research question reference were made to sections; 4.3.1, 4.3.2 and 4.3.3; Tables 3 and 4; Figures 5, 6, 7 and 8, including excerpts from the live classroom observation and interviews.

4.3.1 Findings from descriptive Analysis of the Ways Teachers use TLSMs Grade 11 Chemistry and Physics Classrooms

4.3.1.1 Ways in which Chemistry and Physics teachers use TLSMs for effective teaching of Grade 11 Chemistry and Physics

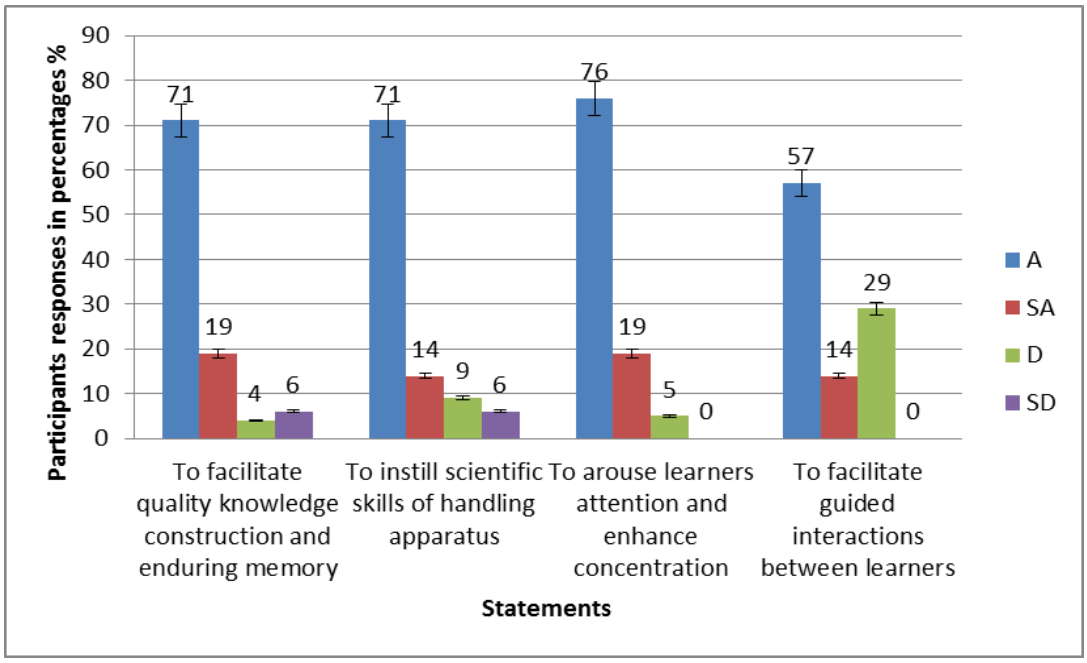


Figure 5: Ways in which Chemistry and Physics teachers use TLSMs for effective teaching of Grade 11 Chemistry and Physics

Figure 5 shows the participants' responses on the ways in which the Chemistry and Physics teachers use different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region of Namibia. Figure 5 revealed that the majority of the participants agreed (71%) and strongly agreed (19%) that they use

TLSMs to help their learners acquire quality knowledge construction and enduring memory of Chemistry and Physics concepts taught. Furthermore, majority of the participants agreed (71%) and strongly agreed (14%) that they use TLSMs to instill scientific skills of handling apparatus in their learners. Majority of the participants (76% agreed and 19% strongly agreed) also indicated that they use TLSMs to arouse learner's attention and enhance their concentration during the lesson. The results further revealed that majority of the participants agreed (57%) and strongly agreed (14%) that they use TLSMs to facilitate guided interactions between the learners using the resources. The findings here suggest that the participants used TLSMs in different positive ways such as instilling scientific skills of handling apparatus, socialization among learners, attracting learners' interest and enhancing long-term memory of learned concepts, which are critical for effective teaching and learning, especially in science subjects such as the Grade 11 Chemistry and Physics.

4.3.1.2 TLSMs used in teaching Grade 11 Chemistry and Physics

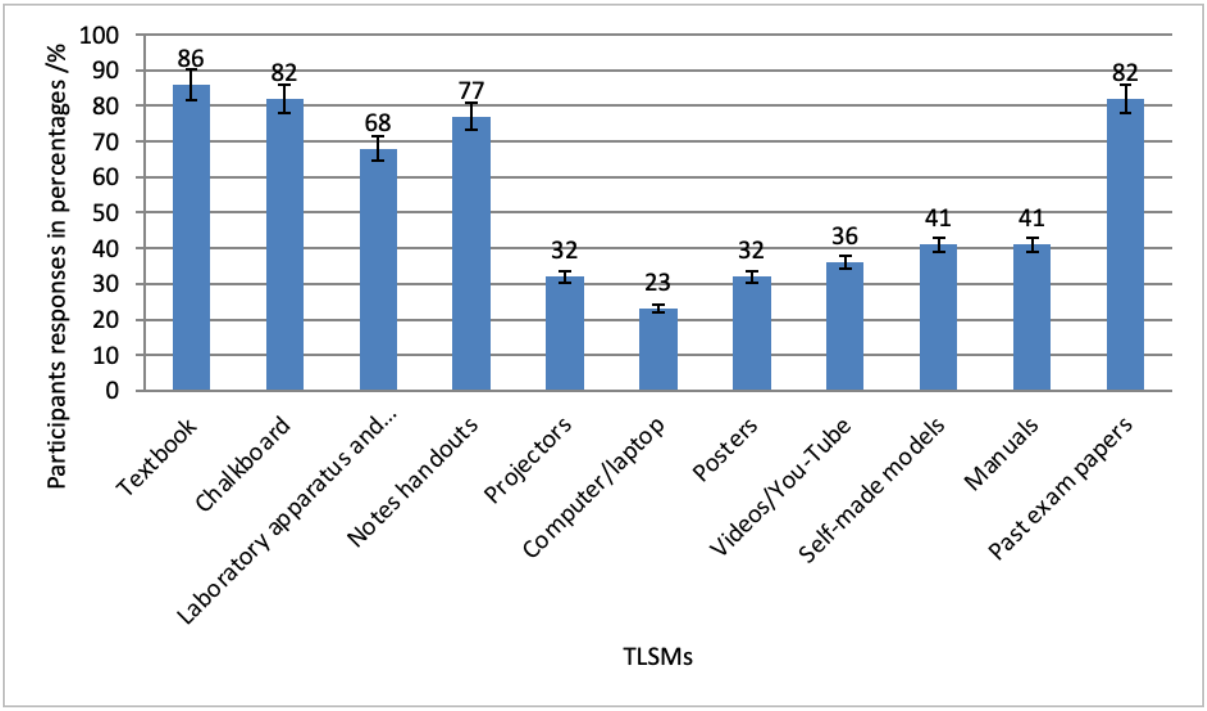


Figure 6: TLSMs used in teaching Grade 11 Chemistry and Physics

The participants were asked to name the different types of TLSMs that they used in teaching Grade 11 Chemistry and Physics in their classroom. Their responses are presented in Figure 6. The findings in Figure 6 revealed that the majority of the participants used textbook (86%), chalkboard and past exam question papers (82% each), laboratory apparatus and chemicals (68%), and note handouts (77%) as TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area. The other results revealed that 41% of the participants used self-made models and manuals, 32% of them used projectors and poster, 36% used YouTube videos, and 23% used computer/laptops. From the responses, it is clear that textbook, chalkboard, past exam question papers and note handouts were the most commonly used TLSMs by Chemistry and Physics teachers teaching in senior secondary schools in the Kavango East Region. Additionally, some participants listed other TLSMs which

they used to achieve effective teaching of Grade 11 Chemistry and Physics in the study area. For example, ***Teacher F1*** *stated that "I use indigenous practices and we used this medium to decolonize the science curriculum, to reflect Africanism, and enable the learners to easily relate the concepts to practices in their environment".* In the same vein, **Teacher D1**, stated that *"we use some good materials made by learners as TLSMs, which are very helpful",* while **Teacher H1,** *emphasized that "we use past exam question papers as TLSMs when preparing Grade 11 Chemistry and Physics learners for their end of year examination".*

4.3.1.3 Regular use of TLSMs during teaching of Grade 11 Chemistry and Physics

Figure 7: Regular use of TLSMs during teaching of Grade 11 Chemistry and Physics

The participants were asked to indicate how regular they made use of TLSMs during teaching of Grade 11 Chemistry and Physics. The findings in Figure 7 revealed that

the majority of the participants strongly agreed (50%) and agreed (40%) that they use TLSMs in every lesson that they teach in Grade 11 Chemistry and Physics while 50% of the participants agreed and another 50% of them strongly agreed that they use TLSMs sometimes. Additionally, 40% of the participants agreed and 20% of them strongly agreed that they used TLSMs only when they want to use the materials in their lessons. Only 12% of the participants respectively agreed and strongly agreed that they do not use TLSMs at all in their lessons. Thus, the result indicated that most of the Chemistry and Physics teachers in Senior Secondary Schools in the Kavango East Region made use of TLSMs in their teachings even though, this is not regular among some participants.

Table 3: Regular use of TLSMs by Chemistry and Physics teachers during their teaching of Grade 11 Chemistry and Physics

Statements	**Participants responses in percentages / %**			
	A	SA	D	SD
In every lesson I teach	-	-	√	-
Sometimes	-	√	-	-
Only when I want to	-	√	-	-
Not at all	-	-	√	-

The findings from the SEO questionnaire (Table 3) indicated that the SEO strongly agreed with the statement that the teachers use TLSMs sometimes during their teachings but disagreed that the teachers used TLSMs in every lesson. The SEO also strongly agreed that the teachers use TLSMs only when they want to use these materials during teaching but disagreed that the teachers do not use TLSMs at all in their lessons. These findings complement the results obtained from the teachers'

questionnaire and show that the Chemistry and Physics teachers use TLSMs in their lessons to strive for effective teaching.

4.3.1.4 The teachers' teaching methods when using TLSMs

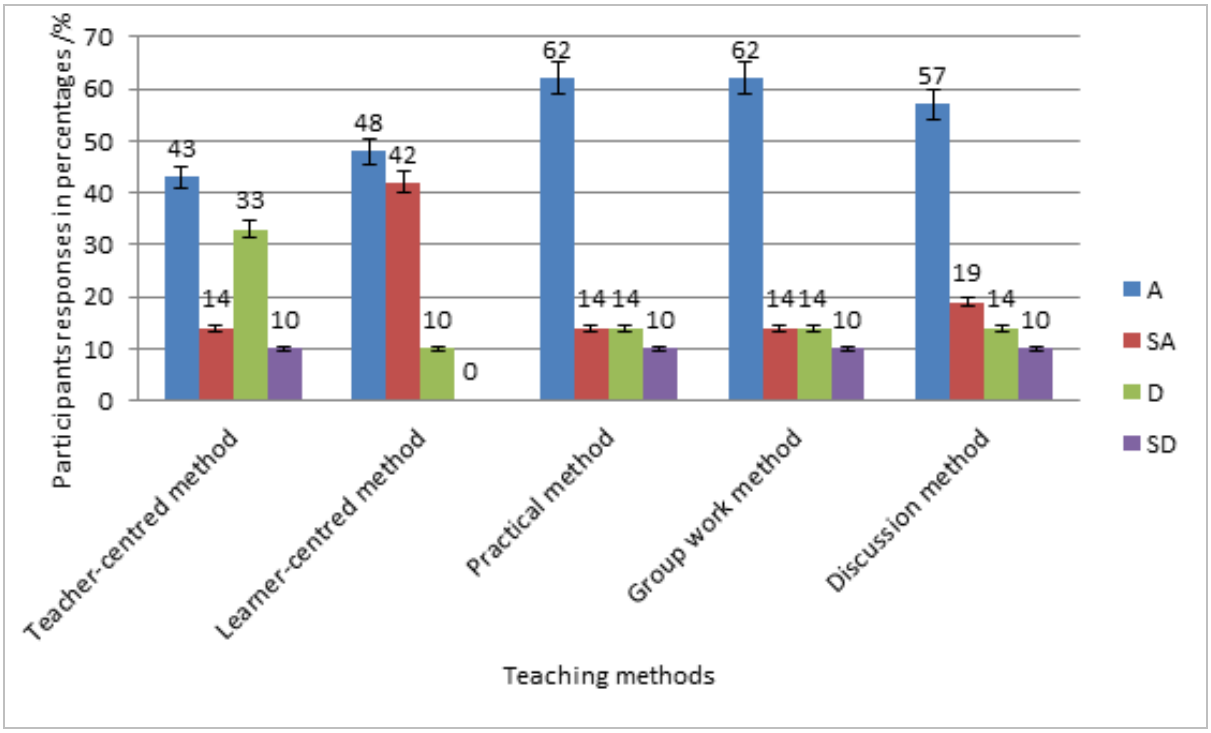


Figure 8: The teachers' teaching methods when teaching using TLSMs for effecting teaching of Grade 11 Chemistry and Physics in classroom

The participants were asked to state which teaching methods they used when teaching Grade 11 Chemistry and Physics in their classroom. The findings in Figure 8 revealed that the majority of the teachers agreed and strongly agreed that they used all the listed teaching methods when teaching Grade 11 Chemistry and Physics. These include teacher-centred method, learner-centred method, practical method, group work method, and discussion method. The use of different teaching methods especially when teaching Chemistry and Physics is necessary to achieve effective teaching of the contents. However, two visibly excited participants added the following: **Teacher F_1**, stated that, *"the learner-centred method is challenging due*

to poor participation by the learners". According to **Teacher O1**, **"***learners should be taken on an excursion tour to discover scientific processes such as chlorination of water at Namwater plant".*

Table 4: The teaching methods Chemistry and Physics teachers are expected to use when they are using TLSMs for effective teaching of Grade 11 Chemistry and Physics in your classroom

Statements	**Participants responses in percentages / %**			
	A	SA	D	SD
Teacher-centred method	√	-	-	-
Learner-centred method	-	√	-	-
Practical method	-	√	-	-
Group work method	-	√	-	-
Discussion method	√	-	-	-

Additionally, the SEO was asked about the teaching methods Chemistry and Physics teachers are expected to use when they are using TLSMs for effecting teaching of Grade 11 Chemistry and Physics in their classrooms. The results obtained were presented in Table 4. The findings indicated that the SEO agreed that the teacher-centred, learner-centred, practical, group work and discussion methods are expected to be used by the teachers for effective teaching of Grade 11 Chemistry and Physics. However, these methods may vary from lesson to lesson as not all the lesson topics can require each teaching method.

4.3.2 Findings from the Interviews

4.3.2.1 Teachers' improvisation when teaching Grade 11 Chemistry and Physics

During the follow-up interview with the teachers and SEO, teachers' improvisation when teaching Grade 11 Chemistry and Physics was strongly highlighted in using TLSMs for effective teaching. The participants reported that they applied indigenous knowledge (IK) which is needed in order to influence effective teaching of Grade 11 Chemistry and Physics using the TLSMs. The excerpts of the responses were given below:

Teacher F1 remarked:

> *Due to the expensive nature of chemicals, we are unable to carry out many practical activities even if you want to go extra mile. However, for some experiments in Physics, for example, on pendulum; this does not need any chemical and we can easily improvise and do that under the tree because it just requires a stone and a rope which we can get right in our environment.*

Teacher J1 remarked:

> *We usually test for carbon dioxide gas using materials we can obtain from our local environment. We can get carbon dioxide from the brew made locally. So, learners will understand that there is also carbon dioxide production in the brews that we drink every day. There are really some learners that can get the concepts from the things that they have never seen before, but there are several other learners who will not get anything at all, unless they see the things so that they will be able to relate them to their everyday life experiences. So, this is really not good in terms of materials*

scarcity in our school. Therefore, in some cases, it forces me to improvise and use some local available things that I can use for demonstration in the class just to teach my learners Chemistry and Physics.

Teacher O1 remarked:

We are forced to improvise which makes it quite stressful for teachers and the learners as well, making the teaching and learning of Chemistry and Physics sometimes a little ineffective. Because of the scarcity of TLSMs, we try to make use of the few materials we have to teach, and at times, we use to improvise on the available materials to provide demonstration of the concepts we are trying to teach.

SEO remarked:

But again, there are many practical activities which do not need a school laboratory; you can even collect some of the needed items within the community itself. For example, if you do not have a gas bottle, you can buy a gas bottle from the local shop there, including match stick and so on. Then, you can make a Bunsen burner for yourself to use. For filtration, parents can even demonstrate it at home; you know that in rural areas, they sometimes have dirty water and they can take a piece of cloth to filter the dirty water; this is community knowledge (CK). So, for that concept you can just try to explain about it, and about what they are doing. The best demonstration is in the community also. Before, I forgot; for example, one of the aspects I encourage my teachers about is that do not waste money to go and buy distilled water. Just collect rain water in a clean container, that is the best way of having distilled water and you can keep it in the storeroom in

laboratory. Even up to 25 litres; so, you are sorted with distilled water and can use it when needed.

4.3.3 Findings from Grade 11 Chemistry and Physics Live Classroom Observations

4.3.3.1 Ways teachers use TLSMs for effective teaching of Grade 11 Chemistry and Physics.

The participants were observed while teaching Grade 11 Chemistry and Physics lessons to note the ways in which the teachers used TLSMs for effective teaching. The findings complemented the questionnaire results on the ways the teachers used TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area. It was observed that all the participants used TLSMs to enhance learners' understanding of the Grade 11 Chemistry and Physics concepts taught. Additionally, 90% of the participants used TLSMs to inculcate skills of handling apparatus in the learners while all the participants used TLSMs to arouse learners' interest and gain attention during their teachings. It was also observed that the participants used TLSMs to facilitate learners' interaction with one another using the resources which lead to effective teaching of Grade 11 Chemistry and Physics. This was observed for the teachers who used TLSMs during the day of my live classroom observation.

4.3.3.2 TLSMs used by the teachers when teaching Grade 11 Chemistry and Physics

A total of ten teachers were observed while teaching and the types of TLSMs they used for effective teaching of Grade 11 Chemistry and Physics were noted. The findings indicated that all the participants (100%) used chalkboard and textbooks as TLSMs when teaching Grade 11 Chemistry and Physics. This is not surprising because chalkboard and textbooks constitute the primary TLSMs readily provided to schools by the government regardless of the subjects concerned. The findings further showed that only 10% of the participants used posters (chats) as TLSMs during teaching.

Furthermore, it was observed that some Chemistry and Physics teachers used Information and Communication Technology (ICT) like Laptops and Projectors as TLSMs during their teaching, teachers in this study used the ICT by projecting using laptops and projectors during their teachings. The uses of ICT tools by the teachers are very good practices which could make the teaching of Grade 11 Chemistry and Physics more interesting and engaging to the learners in the study area. In the same vein, it was observed that all the participants distributed printed handouts to the learners to make the learners follow the lesson discussion more easily. The findings further indicated that 9 out of 10 participants in the live classroom observation used you tube videos to make their teaching more effective, and the learners were fully engaged during the lessons.

The ten selected teachers were also observed on the teaching methods they used when using TLSMs for effecting teaching of Grade 11 Chemistry and Physics in their classrooms. The findings revealed that 90% of the teachers employed teacher-centered teaching method (TCT) by just reading notes from prepared hand-out and only 10% of them used learner-centred teaching method (LCT) during their teachings by grouping learners and learners did the task in groups. This contradicts the findings in the teachers' questionnaire above (42% agreed and 48% strongly agreed that they use LCT when teaching Grade 11 Chemistry and Physics). This showed that even though the Namibian Ministry of Education, Arts and Culture continues to encourage the use of LCT through circulars, seminars and workshops, the majority of the participants are not applying it in their classroom teachings. It was also observed that only 10% of the participants used practical method when teaching Grade 11 Chemistry during the live classroom observation, but this could be because the topics taught by the other participants does not require practical and were mostly theoretical topics. Furthermore, the findings indicated that only 10% of the participants used group work as a teaching method which also contradicted the findings from the questionnaire analysis. However, all the participants used discussion method to make their teaching more effective to the learners. In terms of the physical classroom arrangement, it was observed that the learners were seated in rows instead of groups which totally supported the TCT method earlier observed among 90% of the participants.

4.3.4 Discussion of the results on research question one

The results obtained from the teachers and SEO questionnaires revealed that even though the teachers used different ways when using TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area, they were not using these TLSMs in every lesson they taught in the classroom. The different ways the teachers used TLSMs for effective teaching of Grade 11 Chemistry and Physics include helping the learners to acquire quality knowledge and retaining long term memory of learned concepts, instilling scientific skills of handling apparatus in the learners, arousing learners' attention to enhance their concentration during lesson, and providing guided interactions among the learners when using TLSMs. The guided interaction using TLSMs as indicated by the participants is particularly important for learner's cognitive development because within the context of constructivism theory which underpins this study, Vygotsky (1978) believed that life long process of learning is dependent on social interaction and that social learning actually leads to cognitive development. In other words, all learning tasks (irrespective of the level of difficulty), can be performed by learners under adult guidance or with peer collaboration additionally, Akpan et al. (2020), opined that learning is significant when learners are guided through active participation, to construct or create basic knowledge by themselves. These corroborate an earlier study reported by Tuimur and Chemwei (2015) where the use of TLSMs in classroom teaching showed potential to help the teacher explain new concepts clearly, resulting in better learners' understanding of the concepts being taught.

However, the teachers' decision to use TLSMs in a particular lesson is influenced by the topic that they planned to teach (see section 4.3.3.2). Findings from the live classroom observation complemented the results obtained via the questionnaires. For effective teaching to take place, teachers are encouraged to teach using TLSMs or objects in ways that offers latitude for shaping lessons to students' interests and needs, thereby enhancing the potential of these teaching strategies to be realized in the classroom (Sieber & Hatcher, 2012). In a study conducted in Australia, Loughran, Mulhall and Berry (2004) noted that science teaching using TLSMs is thought to be a combination of teacher's instructional materials and understanding of science content which influence their teaching in ways that will best engender learners' learning for understanding. Additionally, teaching with real-life materials creates interesting as well as exciting teaching and learning environment which contribute to learners' better concepts recognition leading to effective learning (Yalcin, Yalcin, Akar & Sagirli, 2017). Interestingly, Philip and Denwigwe (2017), supported the present results by outlining that in the classroom "instructional materials usage can supply a concrete basis for conceptual thinking, enhance high degree of interest by students, provide the necessary basis for developmental learning and hence make learning more permanent, offer a reality of experience which stimulates self-activity on the part of the pupils, provide experience not easily secured by other materials and contribute to efficiency, depth and variety of teaching and learning processes". Advantageously, TLSMs aid the demonstration and formulation of concepts, instructive techniques, and knowledge of what makes concepts difficult easy to learn, and knowledge of what learners know and theories of subject contents in science teaching (Koehler, 2011).

In Table 3 and Figure 7 the participants named the TLSMs which they used regularly when teaching Grade 11 Chemistry and Physics. The TLSMs mentioned by most of the participants include textbooks, projectors, past exam question papers, examiners' reports, chalkboard, note handouts, self-made models, easily accessible local materials (e.g., shikundu-cultural drink in Kavango East Region), YouTube videos, and laboratory chemicals and apparatus Findings from the live classroom observations complemented the results obtained from the questionnaires as the teachers were seen using some of the above named TLSMs, notably textbooks, posters, laptops, projectors, printed handouts, chalkboard, laboratory apparatus and chemicals which made learners to have fun and grasp the concepts better. This could be viewed as behaviorism learning as the TLSMs used by the teachers made it easier for learners to respond to the teaching and this might enable better understanding of the concept taught or improve student's knowledge of the subject matter. Thus, the teachers should be encouraged to identify these materials and use them regularly for effective teaching of Grade 11 Chemistry and Physics contents to be achieved. In line with the behaviorist theory being one of the theories which underpin this study, Dee (2013) noted that behaviourism learning is accomplished when a proper response is demonstrated following the presentation of a specific environmental stimulus. For example, when presented with appropriate TLSMs, the materials provoked the learners to develop positive learning response according to the stimulus. The Namibian National Curriculum for Basic Education (NCBE) asserts that effective learning and teaching are closely linked to the use of TLSMs (for example, books, posters, charts and recycled waste materials) and ICTs (for example; computers, and audio and visual media) in the classroom (NIED, 2016). In addition, Ayoti and Poipoi (2013) highlighted that TLSMs such as pictures, specimens of

flowers and the likes, attract learners' interest and let them pay attention to what is being taught and make it more understandable.

In a different study, Buchanan (2018) noted that using chalkboard as a teaching and learning support material improves teaching effectiveness, classroom management and students' academic success as the use of chalkboard enables teachers to have a better chance of reaching wide students if they (teachers) have a structured teaching style. Ranga (2013) in his study noted that using chalkboards as TLSMs is a must for teaching in schools and colleges and he added that writing on a chalkboard makes it easier to control the pace of a lecture because it encourages writing while talking, a task that requires instruction at a moderate speed.

The findings from questionnaires and live classroom observation also revealed that the teachers used ICT equipment such as projector and laptop during their teaching to make lesson presentation interesting and clearer to the learners. This is in line with Sigalingging and Budiningsih (2021), who maintained that learners should be given learning materials, ICT, or interesting learning tools to make them interested and motivated in their learning, and to increase their scientific skills of engaging in activities and discussion about the concepts. This is also in agreement with Ghavifekr and Rosdy (2015) who opined that ICT provides the help and complementary supports for both teachers and students where it involves effective teaching and learning with the computers serving the purpose of learning aids. Moreover, the study carried out in Northwest China which revealed that ICT helps teachers to design their lesson plans in an effective, creative and interesting method that would result in students' active learning (Zhang, 2017) and this can result in effective

teaching of Grade 11 Chemistry and Physics. To support the finding further, Stefanc (2012), stated that "ICT provides an enormous deal of continence in teacher's capacity to put across a message to learners in an accurate, proper, clear and understandable manner in making an abstract knowledge concrete and in enabling learners to comprehend complex ideas through simplification". Supporting the ideas of ICT usage in education (see Figure 6 & section 4.3.3.2), Chine, Wu and Hsu (2018) opined that technology-based teaching and learning offers various interesting ways which includes educational videos, stimulation, storage of data, the usage of databases, mind-mapping, and guided discovery that will make the learning process more fulfilling and meaningful. In addition, Koto, Harneli, and Winarni (2018) supplemented the findings that modern technology like ICT, needs to be integrated into the classroom teaching and learning process in order to develop the students' scientific skills required in the new digital society and interpretation of scientific concepts.

Furthermore, findings from the questionnaire and live classroom observations revealed that most of the teachers used different teaching methods for effective teaching of Grade 11 Chemistry and Physics in the study area. The majority (see Figure 8 & Table 4) of the participants indicated that they used the teacher-centred, learner-centred, practical, group work, and discussion methods when using TLSMs for effective teaching of Grade 11 Chemistry and Physics. To contextualize the findings, the social constructivism theory (Akpan et al. 2020), in collaborative learning through meaningful interaction, discussion and knowledge sharing among students, the teacher's role is to employ teaching methods that are learner-centred and collaborative in nature. Moreover, Abaidoo (2018) argued that individual's

ability to learn and think begin from their social interaction necessary for cognitive development. Furthermore, supplementing on findings about teaching methods presented in Figure 8 and Table 4, Muijs and Reynolds (2011) reported that the use of group work teaching method when using TLSMs makes learners to give-and-take their understanding of the subject through interaction with other learners. In another study, Nakanyala (2015) supported the findings where it was noted that if teachers do not use teaching methods that can engage learners to do practical activities, it might decrease their interest in Chemistry and Physics and, this could also lead to ineffective use of TLSMs. However, Kapenda (2008), asserts that some of the teachers in Namibian secondary schools tend to use traditional methods of teaching, due to the fact that group work and practical activities are not easy to be used with the insufficient teaching and learning resources. However, the participants also indicated that the learner-centred teaching method was particularly challenging to them due to the lack of learners' participation as there were lack of resources. The learner-centred teaching method entails that learners primarily do most of the work (be it practical with hand-on materials, writing, or group discussions) in the classroom than just the teacher talking (Namibia National Curriculum of Basic Education (NCBE) (2010).

The results further showed that the teachers used TLSMs during practical activities which are a good practice as the learners would have freedom to direct and adapt the scientific activities according to their burning questions which emerge from their own understandings of the contents. Rob (2012) affirmed that practical activities make learners to be interest in doing science activities. Most learners found practical lessons interesting because they could explore and observe what they are learning in

a way that brings to life what have been explained in textbooks (Nakanyala, 2015). This emboldens them at various stages of inquiry to "predict, explain, explore, observe and explain (PEEOE)" their action (Maselwa & Ngcoza (2003).

The findings from Figure 6 also showed that most teachers used past exam question papers to prepare learners for examination, YouTube to get supplementary notes from electronic textbooks, and note handouts to make learners understand the lesson contents. Besides, both the teachers and SEO indicated that textbooks are the main daily-used TLSMs by most teachers when teaching Grade 11 Chemistry and Physics in Kavango East Region. Textbooks are the main regular TLSMs which provide vast information as stipulated in the syllabi. Therefore, if the teachers choose and use textbook correctly, learners are likely to grasp most of the contents which can lead to effective teaching and learning of the subjects. Similarly, the National Institute for Educational Development (NIED) (2008) noted that textbooks as TLSMs often provide detailed guide on what learners ought to learn, what should be taught, and where teachers based their lessons. Furthermore, NIED (2008) submitted that without a textbook as teaching aids, many teachers may not be able to teach effectively, especially where teachers might be inadequately trained. In such a case, the textbook is an indispensable resource. Gradana (2017) explained that textbook is a standard reference teaching material for formal study of a subject and an instrument for teaching and learning. However, Basturkmen (2010) cautioned that the content or examples in some textbooks may not be relevant or appropriate to the students and may not reflect their needs since textbooks are often written for global markets and often do not reflect the interests and needs of specific students.

Both the teachers and SEO maintained that TLSMs can significantly improve students' achievement by supporting student's learning. Additionally, during the interview, the SEO emphasized that *"the best way to utilize any resources should be associated with the worksheet which contains the instructions and the resources which are required and it should be in a very simple language for learners to understand without compromising the scientific principles".*

During the interview too, Teacher F1 asserted that *"in term of Physics, when we are talking about parallel and series circuit, and in a school which is having resources, those learning materials can help the learners to quickly see the difference between parallel and series circuit. If the circuit boards are readily available, it is easy for the learners to see what will happen to the series circuit if one bulb got fused or one bulb is not working and what will happen to the parallel circuit under the same condition".*

Interestingly, the participants pointed out that indigenous knowledge practices and learner-made materials are essential TLSMs to make the teaching of Grade 11 Chemistry and Physics more effective in the classroom. It is a good practice to link scientific knowledge with the indigenous knowledge (IK) as learners finds it easier to integrate the knowledge with their cultural background and understand the subject contents better. According to Mosimege and Onwu (2004), IK is an all-inclusive knowledge that covers technologies and practices that have been and are still used by indigenous and local people for existence, survival and adaptation in a variety of environments. Therefore, teachers are encouraged to teach classroom activities by

bringing concepts of IK that link community science to school science and close the gap between classroom and the community.

4.4 Research Question Two

What factors constrain Chemistry and Physics teachers from using different TLSMs to effectively teach Grade 11 Chemistry and Physics contents in the Kavango East Region?

In answering this research question reference were made to sections; 4.4.1, 4.4.2 and 4.4.3; Tables 9; Figures 9, 10, 11, 12, 13 and 14, including excerpts from the live classroom observation and interview.

4.4.1 Findings from descriptive analysis of the factors constrain Chemistry and Physics teachers from using different TLSMs to effectively teach Grade 11 Chemistry and Physics content.

4.4.1.1 Problems experienced by teachers when using TLSMs to teach of Grade 11 Chemistry and Physics

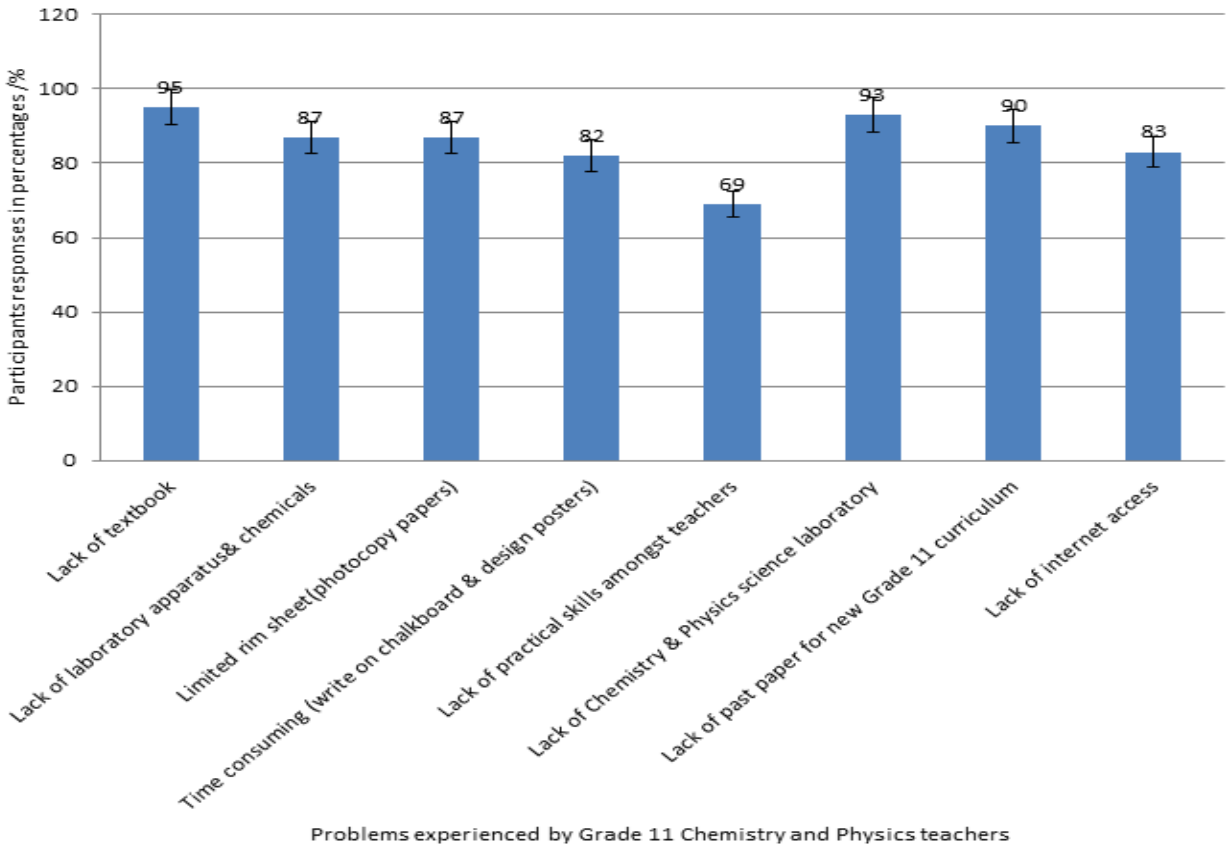


Figure 9: Problems experienced by teachers when using the TLSMs in teaching of Grade 11 Chemistry and Physics

The participants (Chemistry and Physics teachers) were asked to state the problems they experienced when using TLSMs in teaching of Grade 11 Chemistry and Physics at their schools. The findings (Figure 9) revealed that majority of the participants consistently indicated that they have challenges of lack of the following: textbook (95%), laboratory apparatus (87%), photocopy papers (87%), practical skills (69%), Chemistry and Physics laboratories (93%), past exam question papers (90%), lack of internet access (83%), and spent too much time writing on chalkboard (82%). From Figure 6, if the schools lack most of these TLSMs to be used when teaching Chemistry and Physics, it is likely that effective teaching of Grade 11 Chemistry and Physics will not be realised in the study area.

Table 5: Problems experienced by teachers using teaching and learning support materials in Grade 11 Chemistry and Physics classroom

Statements	A	SA	D	SD
Teachers have plenty TLSMs at their schools	-	-	-	√
All our Grade 11 learners have their own Physics and Chemistry textbooks	-	-	√	-
All schools have a well-equipped Physics and Chemistry laboratory.	-	-	-	√
Teachers do not have enough materials for doing practical's	√	-	-	-

The SEO acknowledged the lack of some TLSMs as stated by the teachers in their questionnaires. The findings in Table 5 indicated that SEO strongly disagreed with the statement that Chemistry and Physics teachers have plenty TLSMs at their schools. In addition, the SEO disagreed with the statement that all Grade 11 learners in the Kavango East Region have their own Chemistry and Physics textbooks. Furthermore, the SEO strongly disagreed with the statement that all secondary schools in the Kavango East Region have a well-equipped Chemistry and Physics laboratory. Therefore, the findings revealed that the Chemistry and Physics teachers do not have enough TLSMs for effective teaching of these subjects in the study area.

4.4.1.2 Teachers subject knowledge (TSK) when using TLSMs for effective teaching of Grade 11 Chemistry and Physics.

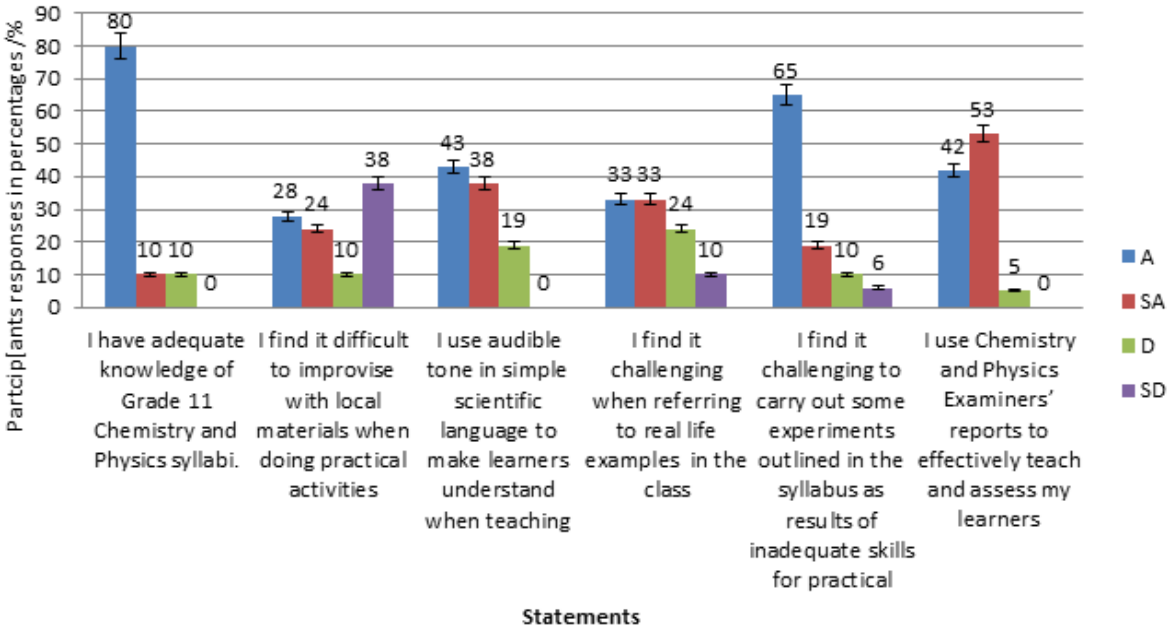


Figure 10: Teachers subject knowledge when using TLSMs for effective teaching of Grade 11 Chemistry and Physics.

The results presented in Figure 10 shows the teachers' views on their subject knowledge when using TLSMs for effective teaching of Grade 11 Chemistry and Physics. Figure 10 indicates that the majority of the participants (Chemistry and Physics teachers) agreed that they have adequate subject content knowledge (80%), teach with audible tone (38%), and strongly agreed (53%) that they use Chemistry and Physics Examiners' report to teach their learners effectively. Unfortunately, some participants agreed (28%) and strongly agreed (22%) that they find it difficult to improvise when they are doing practical activities while 33% each agreed and strongly agreed that they find it challenging to provide real life examples in class. These results implies that most of the participants have challenges in improvising on local materials and in giving real examples of concepts being taught using TLSMs to link science to the background knowledge of the learners. Thus, there is a need for

the teachers to be provided with laboratory apparatus to eradicate lack of improvisation and to make learners see and use real life examples of apparatus and chemicals in the classroom.

Table 6: SEO's rating of the Physics and Chemistry teachers' subject knowledge when using TLSMs for effective teaching of Grade 11 Physics and Chemistry

Statements	**A**	**SA**	**D**	**SD**
Teachers displayed adequate knowledge of Grade 11 Physics and Chemistry when using TLSMs	√	-	-	-
Teachers find it difficult to improvise with local materials when doing practical activities in Physics and Chemistry.	√	-	-	-
Teachers use audible tone in simple scientific language to make learners understand Grade 11 Physics and Chemistry Contents.	√	-	-	-
Teachers sometimes find it challenging when referring to real life materials in some chemistry sections.	-	√	-	-
Teachers find it challenging to carry out some experiments outlined in the syllabus as a result of inadequate skills for practical.	-	√	-	-
Teachers use Physics and Chemistry Examiners reports to effectively teach and assess their learners.	-	√	-	-

What is more important is that the SEO was asked to rate the Chemistry and Physics teachers' subject content knowledge when they are using TLSMs for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region. The results in Table 6 revealed that the SEO agreed with the items 1,2,3, and 6 that suggest that the teachers have some subject knowledge of Grade 11 Chemistry and Physics when using TLSMs during their teachings however, SEO also agreed that teachers have challenges carrying out some experiments outlined in the syllabus as a result of inadequate skills for practical and sometimes find it challenging when referring to real life materials in some chemistry sections in items 6 and 4 respectively.

4.4.1.3 Challenges of teaching Grade 11 Chemistry and Physics curriculum using the available TLSMs

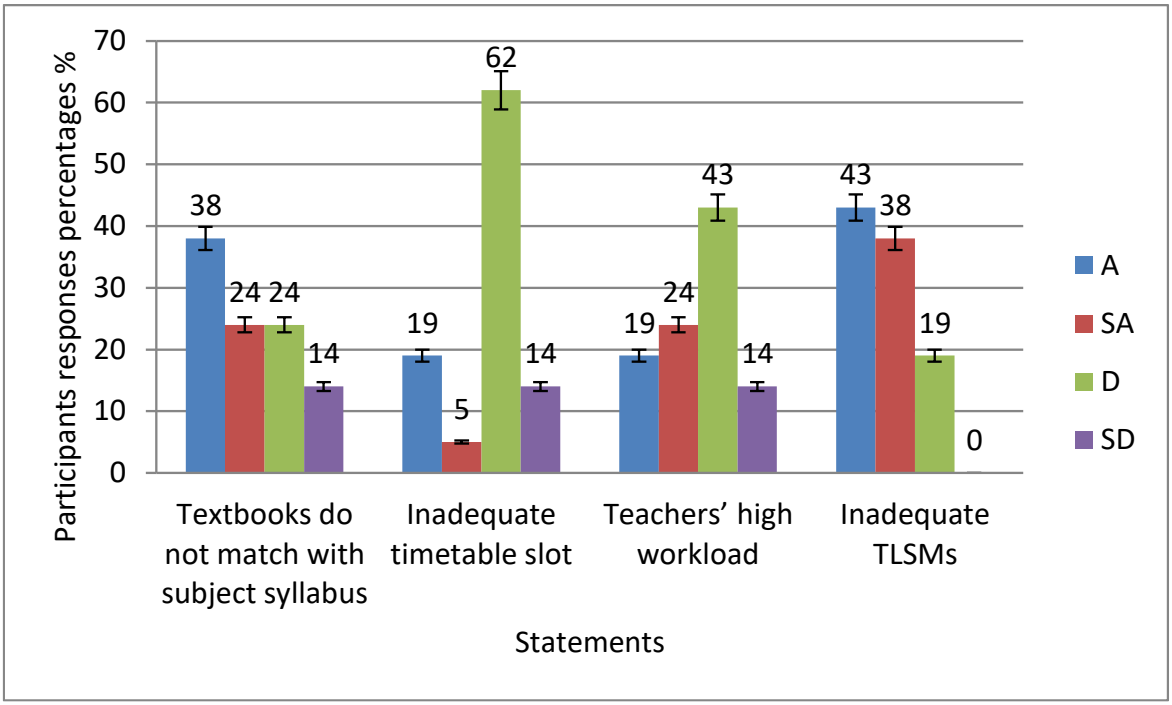


Figure 11: Challenges of teaching Grade 11 Chemistry and Physics curriculum using the available TLSMs.

The participants' responses on the challenges of teaching Grade 11 Chemistry and Physics curriculum using the available TLSMs in their schools are presented in Figure 11. The results showed that majority of the participants (38%) agreed that Grade 11 Chemistry and Physics syllabi do not match with some textbooks supplied to their schools. This has a serious implication for effective teaching and learning outcomes as teachers will find it difficult to teach these subjects using the available textbooks as TLSMs. However, the results showed that the required timetable slots were not a challenge for the teachers as 62% of the participants disagreed and 6% of them strongly disagreed with the statement. Despite 19% of the participants agreeing and 24% of them strongly agreeing that they have of teachers' high workload in their

schools, the majority (43%) disagreed and 14% of them strongly disagreed that they are overloaded with their works. The findings also showed that majority of the participants agreed (43%) and strongly agreed (38%) that TLSMs specified in the Grade 11 Chemistry and Physics curriculum are not provided at their schools. These results indicated that the teachers faced different challenges when teaching Grade 11 Chemistry and Physics using TLSMs in the study area.

Table 7: SEO's responses on the teachers' challenges of teaching Grade 11 Chemistry and Physics curriculum using TLSMs

Statements	**Participants responses in percentages / %**			
	A	SA	D	SD
Grade 11 Chemistry and Physics syllabi do not match with some textbooks supplied to schools.	-	-	-	√
Required period in the syllabus and policy of Grade 11 Chemistry and Physics is not reflecting on the teachers' timetable.	√	-	-	-
Inadequate number of Chemistry and Physics teachers at schools to effectively teach the curriculum.	-	√	-	-
Teachers are overloaded with Grade 11 Chemistry and Physics lessons per cycle.	-	-	√	-
TLSMs specified in the Grade 11 Chemistry and Physics curriculum is not supplied to schools.	-	-	√	-

Table 7 presents the SEO's responses on the teachers' challenges of teaching Grade 11 Chemistry and Physics curriculum using TLSMs in the study area. The findings showed that the SEO strongly disagreed that Grade 11 Chemistry and Physics syllabi do not match with some textbooks supplied to schools. Furthermore, the SEO agreed with the statement that the required period in the syllabus and policy of Grade 11 Chemistry and Physics is not reflecting on the teachers' timetable. Table 7 further showed that the SEO strongly agreed with the statement of inadequate number of Chemistry and Physics teachers at schools to effectively teach the curriculum.

However, the SEO disagreed with the statement that the teachers are overloaded with their works. The SEO also disagreed with the statement that TLSMs specified in the Grade 11 Chemistry and Physics curriculum are not supplied to schools. Some of these contradicted the responses provided by the teachers on the same issues in the preceding section.

4.4.1.4 The teacher's commitments when using TLSMs to teach Grade 11 Chemistry and Physics

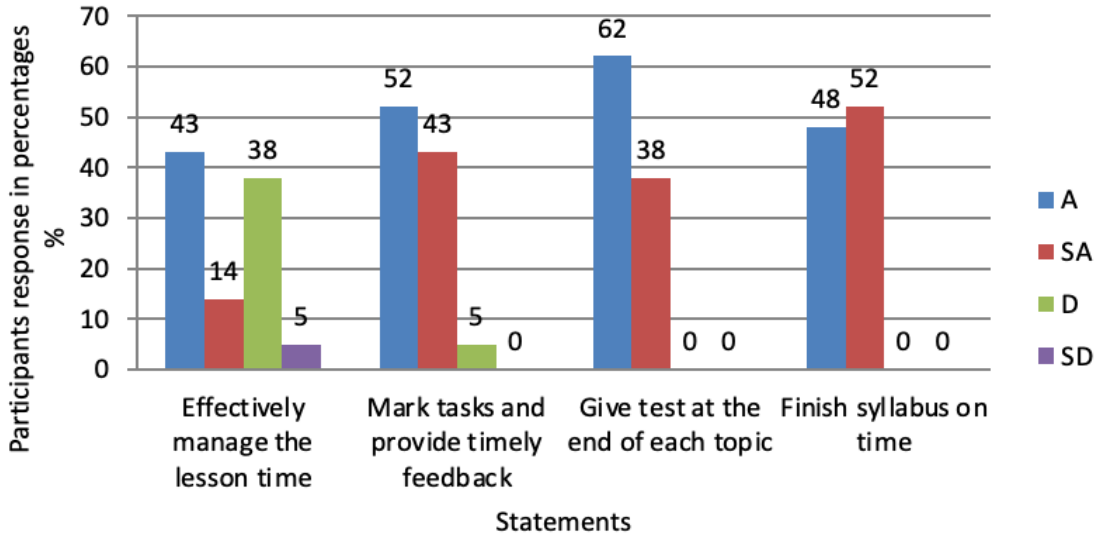


Figure 12: The teacher's commitments when using TLSMs in their teaching of Grade 11 Chemistry and Physics at school.

The participants were asked to choose from the statements with regards to their commitments when they are using TLSMs to teach Grade 11 Chemistry and Physics at their schools. The findings (Figure 12) revealed that the participants are committed to their job when using TLSMs in teaching Grade 11 Chemistry and Physics in the study area. The results indicated that majority of the teachers (43%) managed their

lesson time effectively. The results also showed that majority of the participants (52%) indicated that they mark all their learners' tasks and give them corrective feedback. Additionally, 62% of the participants indicated that they always give tests at the end of the topic. Furthermore, the findings indicated that 48% of the participants agreed and 52% of them strongly agreed that they always strive to complete the syllabus on time. These results revealed that the teachers are committed to their teaching for to achieve effective teaching of Grade 11 Chemistry and Physics.

Table 8: SEO's responses on teachers' commitments when using TLSMs in their teaching of Grade 11 Chemistry and Physics at schools

Statements	**A**	**SA**	**D**	**SD**
Teachers manage their lesson time effectively whenever doing practical activities.	-	-	√	-
Teachers mark all the topic tasks they give to their learners and provide corrective feedback clearly on the chalkboard.	-	-	-	√
Teachers always give a test at the end of each in Grade 11 Physics and Chemistry.	-	-	√	-
Teachers always strive to finish their Physics and Chemistry syllabus on time.	-	-	√	-

However, as seen in Table 8, the SEO's responses on the same issues contradicted the teachers' responses. The findings in Table 8 indicate that the SEO disagreed with the statement that the teachers managed their lesson time effectively. In addition, the SEO strongly disagreed with the statement that the teachers mark all the tasks they give to their learners and provide timely corrective feedback. Furthermore, the SEO disagreed with the statement that teachers always give a test at the end of each topic. The SEO also disagreed with the statement that the teachers always finish their Chemistry and Physics syllabus on time.

4.4.2 Findings from the Chemistry and Physics teachers and SEO Interviews

The findings on the factors that constrain Chemistry and Physics teachers from using TLSMs for effective teaching of these subjects in Grade 11 in the study area are as presented below.

4.4.2.1 Scarcity of TLSMs for Grade 11 Chemistry and Physics

One of the issues which came out most strongly from the interviews was scarcity of TLSMs in the study area. During the interview, the participants highlighted that scarcity of TLSMs was one of the factors hindering Chemistry and Physics teachers from using TLSMs for effective teaching of Grade 11 Chemistry and Physics. The excerpts from the interviews were presented below.

Teacher F1 highlighted that:

> *The scarcity of teaching and learning materials in Chemistry and Physics subjects is very challenging, especially with this new curriculum that we are teaching. We do not have any teaching materials to teach practical as suggested in the syllabus and prescribe textbooks.*

In addition, Teacher H1 remarked that:

> *My school is one of the schools that are having scarcity of TLSMs. So, I respond to that by getting little help from teachers from nearby schools. And what I do mostly is that I made copies from the teachers' book because there are not enough textbooks at our school.*

Teacher L1 also remarked that:

In my opinion and from experience also, TLSMs are very scarce in two ways. One way I am going to submit is that we really do not have materials at our school. And at this point, schools may be required to assist in buying these materials. The little amount of money that the schools received as grant can only cater for a few TLSMs. The second way is even if the materials were to be purchased; it takes time before the materials will be delivered. This makes it difficult for teachers to use the materials in their teachings. And even by the time the materials are delivered, the learners might be already in examination.

Furthermore, Teacher M1 remarked:

There is scarcity of the TLSMs in our region as a whole. You see the problem; number one, the subject advisor from the regional office does not provide us with learning and teaching materials for Grade 11 Chemistry and Physics. So, we have to source for TLSMs by ourselves; we go online and source for materials. But it is really challenging because sometimes those things that you get online might not be of the standard of our learners or our syllabus. This really affects the use of TLSMs by us, the teachers as well as learners.

Teacher Q1 remarked that:

Actually, these materials are really scarce and we do not have them to teach our subjects of Grade 11 Chemistry and Physics effectively. For me, normally what I use to do is that, I use other alternatives such as videos and I use to take my learners to the lab, then they visualize.

Also, Teacher O1 highlighted that:

If we are talking about the fully fledged laboratory, they are quite good and very much effective when using teaching and learning materials to teach Grade 11 Chemistry and Physics, but due to the scarcity of it, it becomes difficult at our school, and theory dominates.

The SEO highlighted that:

Most teachers are unable to conduct experiment because they don't have equipment or materials to use. Under the new curriculum, schools are facing scarcity of these teaching and learning materials in both Grade 11 Chemistry and Physics. So, it becomes difficult since there will be few materials for every learner. The main idea is you want every learner to engage but with the few materials available, only few learners might be engaged. Therefore, the learners are not always exposed to these teaching and learning materials, and that is why at the end, you find that they are confused when using these materials, and are not sure whether they are going to get good results or not.

Moreover, the SEO stated that "some teachers did not handle such support materials during their formal schooling and tertiary training respectively, and thus they are hyper phobic (fearful) to use science equipment and consumables (chemicals) in their lessons". This fear may force some of the Chemistry and Physics teachers to ignore the use of teaching method such as practical activities which require the use of TLSMs and rather resort to theory-oriented teaching. These findings were consistent with what the teachers and SEO indicated in their questionnaires. In all cases, the participants indicated that the schools do not have enough TLSMs. The findings further indicate that the teachers use to go extra miles to try and source the TLSMs to use to make their learners understand the Chemistry and Physics topics better.

4.4.2.2 Overcrowded Grade 11 Chemistry and Physics classrooms and practical teaching

During the interview, both the teachers and SEO identified overcrowded classrooms as one of the factors affecting the teachers' uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region, Namibia, and the participants consistently stressed how this affected practical teaching.

Teacher F1 said:

> *When you have to group learners during practical lessons, that time will be wasted, because they are too many in the classroom to use the little materials. There is no way you can present or use the few materials like that unless, you place them in an affordable group to teach, which allow at least a number of them to use the available materials during teaching and learning.*

Teacher H1 mentioned that:

> *Last but not least, is overcrowding of classes. Our classes are overcrowded; sometimes making it more difficult to teach and assess the learners effectively using teaching support materials which affect the teaching and learning of Grade 11 Chemistry and Physics. These big numbers of learners even make it impossible for teaching practical activities as materials are not enough to be shared or used equally amongst the learners.*

Teacher J1 shared that:

> *In one short thing or practical, you can even take two to three hours because each learner wants to do it one by one and then our classroom is overcrowded. The only solution to this big group is to re-plan for extra time to cater for all the learners in using a certain apparatus and equipment.*

Furthermore, Teacher F1 remarked that:

> *With the 40 learners in my class, I always divide them in into 4 groups of 10 learners each. In this way, each learner might have a chance of using the available materials. Therefore, these big numbers of learners in a class makes it a challenge to do practical effectively in Grade 11 Chemistry and Physics classes.*

The SEO also maintained that:

> *Some schools are overcrowded to the point that teachers are unable to conduct the experiment involving all the learners with the already little resources available. Therefore, teachers depend more on teacher-centred teaching method than the recommended learner-centred method in some schools in the region. But the region tried to minimize the number of learners in a class for Grade 11 at schools during placement each year. Thus, the results are that the use of teaching-learning materials is at minimal.*

The findings from both the teachers and SEO clearly revealed that the overcrowding of classes was one of the factors which constrained Chemistry and Physics teachers from using TLSMs to effectively teach the subjects in the study area.

4.4.2.3 Learners' poor English Second Language backgrounds

The participants expressed that the learners' inability to communicate fluently in English language also have negative impact on teachers' uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region, Namibia. The responses were as follow:

According to Teacher F1,

"The teachers are trying but the main problem is the learners. Due to the language barrier that we have in some village schools, the learner-centred approach becomes very challenging and a waste of time. We always tried but learners do not understand the Basic English used in the two subjects. Even if we are to have materials, English will still be an obstacle in our school".

In addition, Teacher J1 remarked:

> *Sometimes, it seems that they might not be able to put it into practical because of the language barriers among our learners. At least, they would be able to understand what they can remember from the materials if the language of instruction was our own vernacular language and not English. I suggest that Chemistry and Physics books be translated in vernaculars maybe, this will help them to understand the contents better and find it easy to use the available materials.*

These findings revealed that the poor English Second Language amongst the Grade 11 Chemistry and Physics learners made it difficult for the teachers to teach effectively using TLSMs. This is truly the case in the study area because majority of the learners came from poor English Language backgrounds making them unable to understand basic scientific English unless, teachers have to code switch, which can have a negative impact on learners' performance in examinations.

4.4.2.4 Lack of workshops for Chemistry and Physics teachers on practical and materials usage

During the interview with the teachers and SEO, the lack of workshop on practical use of TLSMs was stressed as one of the challenges affecting teachers' uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region, Namibia. During the interview, the participants reported as per the excerpts below:

According to Teacher O1,

> *Teachers should be exposed to workshops and be trained on how to use TLSMs so that they can deliver effectively to the learners. Not just on the change or transformation of the curriculum only that workshops are being conducted in our region.*

Teacher R1 remarked:

> *I think workshop should be conduct on how to create these materials. This is because not every teacher has the knowledge on how to come up with materials. And also, if maybe the materials are being given to the teachers, then we have to be given an induction like, how are you going to do this one within this 40 minutes, since we know given 40 minutes to teach science subjects are really hard. Maybe, you have to start with this and end with that. This induction especially should be given to the new teachers who just entered the profession either by senior teacher or by subject advisor; I think it will really help.*

Moreover, Teacher J2 remarked:

> *I will recommend that the regional office or the cluster centres have regular workshops with teachers. These workshops should concentrate on how the teachers will use the materials so that teachers can go and use the little materials and show learners how they did it at the workshop. It is true that*

not all teachers were trained on the usage of teaching and learning support resources.

The findings revealed that there are no or few workshops organized for Chemistry and Physics teachers based on the usage of TLSMs in the study area; rather they only attend workshops on curriculum reforms. The results showed that both novice and experienced Chemistry and Physics teachers in the study area need dedicated capacity building workshop on how they can use TLSMs to effectively teach Grade 11 Chemistry and Physics in the classrooms.

4.4.2.5 Challenges of using learner-centred teaching method in teaching Grade 11 Chemistry and Physics

The major challenge that the teachers encounter with the use of TLSMs in implementing learner-centred teaching (LCT) method for the effective teaching of Grade 11 Chemistry and Physics in the schools was the scarcity of the relevant materials. During the teacher's interview, majority of the participants seem to recognize the importance of using LCT for effective teaching of Grade 11 Chemistry and Physics but stressed the scarcity of TLSM as their constraint with using this teaching method.

As seen in the excerpts from the interview;

Teacher M1 highlighted that:

LCT is an excited method of teaching and learning. When materials are available, it is supposed to be an interesting method but when you have limited materials, it will be mostly the teachers using the little equipment just

to demonstrate to the learners. Otherwise, if there are textbooks and apparatus where the learners are exposed, the teachers will be responding to the LCT method which will make teaching and learning of Grade 11 Chemistry and Physics effective.

Teacher F1 remarked:

So, we supposed to employ the teacher…aiy, I mean LCT method. Aaah, but in my experience, the LCT with these few TLSMs will not materialize. With the limited TLSMs, learners are too inactive. Yaa, they don't have anything. Like ok, I remember the other time that I brought in a shoe. aah, a shoe… or how do you call it, a horseshoe magnet, you find that only few kids are participating; only those verbose ones and they want to benefit more from the LCT method but the shy ones are always behind. Then, you see at the end of the day that teachers are ignoring the LCT method and opting for teacher-centred teaching method (TCT). So, instead of the learners asking questions in classes, the teacher now ask questions and the learners just provide the answers verbally. Even though the learners will be answering, the teacher will still lead the learners to the answers, which is still more TCT.

Teacher O1 remarked:

Even though we have the ongoing scarcity of teaching and learning materials, we try to follow LCT method here and there. Usually, we could respond to the LCT method but we are unfortunate due to insufficient materials. So, we usually organize learners into small groups and then instruct them to carry out the given task. So, the learners themselves carry out the task while the teachers have to supervise from one group to another.

Teacher Q1 remarked:

I believe that when learners are carrying out their practical activities most of the times, they are the ones who are engaged in the activities. And this is based on the LCT method. So, it really engages in LCT method when using TLSMs in the classroom because most of the times, learners are the ones who carry out the practical and handling the equipment. Mostly, it is the learners who are working and I believe it accompanies the LCT method even though we are not using it most often because we do not have enough materials for everyone during the teaching and learning process.

Teacher R1 remarked:

LCT is about learners doing much work. The teacher is supposed to only introduce the topic or lesson just with few examples, and from there, the learners can do more of the work by themselves. So, before learners can do more work, the teacher has to at least use the supporting materials for teaching and learning. The teacher has to give information to the learners; that is, the information which the teacher has downloaded or gotten from different sources. Give exercises or activities to test the learners. So, all these are LCT method. Unfortunately, in our region, the lack of teaching materials puts us down all the times in teaching Grade 11 Chemistry and Physics.

Teacher J2 remarked:

These will depend on the availability of resources, if the learning materials are enough, then the teacher will respond well to the LCT method but if vice versa, then other methods such as group methods and TCT can be employed just to deliver the contents to the learners.

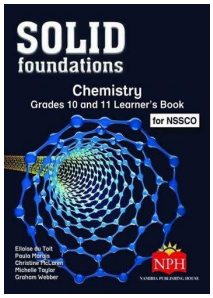
Teacher H1 remarked:

Yes, I think so, because learners will be doing most of the tasks on their own when using teaching and learning materials and it becomes more LCT method. The learners will understand better when they are seeing things and doing things on their own. They are also able to relate the concept to the real world situation in their community or village.

4.4.3 Findings from live classroom observations

4.4.3.1 Availability of TLSMs which teachers use for effective teaching of Grade 11 Chemistry and Physics

The Chemistry and Physics teachers were observed while teaching and the availability of TLSMs which they used during the teaching in their classrooms were noted down. The majority (90%) of the participants observed had very few TLSMs and only 10% of them had several TLSMs for teaching Grade 11 Chemistry and Physics. In all the classes observed, both the Chemistry and Physics teachers, and some of their learners were seen with copies of Chemistry and Physics textbooks. The textbooks used by both the teachers and learners include Namibia College of Open Learning (NAMCOL) and Solid Foundations Chemistry and Physics textbooks (see Figure 13-14 below).



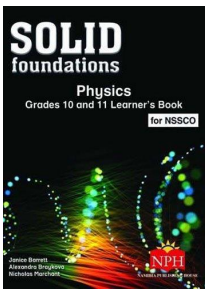
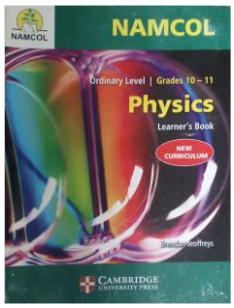


Figure 13: Chemistry and Physics Textbook: Solid Foundations



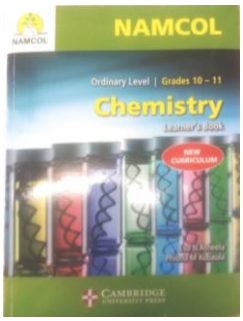


Figure 14: Physics and Chemistry Textbook NAMCOL

Furthermore, the majority (80%) of the participants do not have well-equipped Chemistry and Physics school laboratories.

Table 9: TLSMs provided to Physics and Chemistry teachers for effective teaching of the subjects in Kavango East Region

Statement	A	SA	D	SD
Chalkboard	-	√	-	-
Posters	√	-	-	-
Textbooks	-	√	-	-
Charts	√	-	-	-
Recycled materials	√	-	-	-
ICT (Laptops / Desktop computer / internet / Projectors / Overhead Projectors (OHP))	-	-	-	√
Printed media (Handouts)	-	√	-	-
Laboratory Chemicals	√	-	-	-
Videos (You Tube)	√	-	-	-
Laboratory scientific Apparatus	√	-	-	-

The SEO was asked about the TLSMs provided to the teachers in Kavango East Region for effective teaching and learning of Grade 11 Chemistry and Physics and the responses are reported on Table 9. The findings indicate that the SEO agreed that

the Chemistry and Physics teachers in Kavango East Region are provide with TLSMs like posters, charts, recycled materials, laboratory chemicals, videos (You Tube) and laboratory scientific apparatus for effective teaching of Grade 11 Chemistry and Physics. Moreover, the SEO strongly agreed that chalkboard, textbooks and printed media (handouts) are provided to Chemistry and Physics teachers in the study area. However, SEO strongly disagreed that the teachers are provided with TLSMs (ICT-laptops, desktops and projectors to be used in the newly implemented curriculum of Grade 11 Chemistry and Physics. This might be the case due to the fact that most schools selected in the study do not have ICT facilities.

4.4.3.2 The teacher's subject knowledge (TSK) when using TLSMs for effective teaching of Grade 11 Chemistry and Physics

During the live classroom observation, the teachers' subject knowledge when using TLSMs for effecting teaching of Grade 11 Chemistry and Physics was observed and noted. The finding indicates that all the participants demonstrated adequate knowledge of the Grade 11 Chemistry and Physics subjects. Furthermore, it was observed that the teachers used audible tone in simple scientific language to make learners understand the concepts being taught in the classes. Throughout the live classroom observations, it was observed that all the participants did not find it challenging when giving examples of real life TLSMs in Grade 11 Chemistry and Physics. Interestingly, it was further observed that all the participants used Grade 11 Chemistry and Physics Examiners reports with previous question papers to teach and assess learners.

4.4.3.3 The teacher's commitments when using TLSMs in teaching Grade 11 Chemistry and Physics

The teachers' commitments were also observed during the live classroom observations for the ten participants involved in the observation study. In terms of time management, 50% of the participants managed their time effectively for being on task while 50% of them did not manage their time effectively. This was due to the teachers coming late to classes for the lessons. However, all the participants marked the tasks given to the learners and provided corrective feedback on the chalkboard.

4.4.4 Discussion of the results on research question two

The results obtained from questionnaires showed that the major factors that constrain Chemistry and Physics teachers from using TLSMs to effectively teach the subjects in the study area include insufficient Chemistry and Physics textbooks for every learner, insufficient laboratory chemicals and apparatus, and lack of workshops to train the teachers on the design and effective use of TLSMs in teaching Grade 11 Chemistry and Physics. The results from teachers' interviews further revealed that the inadequate TLSMs in the schools make learners to be inactive and do not participate well in the lessons. This can make teaching more teacher-centred than learner-centred, and affect effective teaching of Grade 11 Chemistry and Physics using TLSMs. Also, findings from the follow-up interviews and live classroom observations complemented the results obtained via the questionnaires. Therefore, these factors could adversely affect the teachers' effective teaching of Grade 11 Chemistry and Physics in the area and performance of learners might be affected. The results further showed that the biggest problem the teachers experienced is the

lack of TLSMs for effective teaching of Grade 11 Chemistry and Physics. In a different study, Nakanyala's (2015) maintained that effective teaching is constrained in the schools where there are inadequate facilities. Oladejo's (2011) also opined that mastery of Physics concepts cannot be fully achieved without the use of instructional materials to supplement verbal explanation of concepts so that the lesson could be real to the learners which can make their learning more effective. Similarly, Krishnasamy, Veloo and Hooi (2013), posit that for effective teaching to prevail, teachers should use TLSMs to help facilitate effective teaching of science subjects as the TLSMs help to gain learners' attention and maintains their interest so that they can acquire and master the appropriate skills. In a different study, Onche (2014) pointed out that lack of using instructional materials and practical lessons in secondary schools was very much related to insufficient skills and creativity among the teachers.

The results from the questionnaires indicated that the teachers have adequate subject knowledge of Grade 11 Chemistry and Physics which is helpful when using TLSMs in order to achieve effective teaching of the contents. The findings from the follow-up interviews and live classroom observations also indicated that all teachers had adequate knowledge of the Grade 11 Chemistry and Physics subjects. Jacobs, Vakalisa and Gawe (2011) stated that it is imperative for the subject teachers to have good knowledge of the content they are teaching in order to help learners to understand the subject.

However, the descriptive analysis of the teachers' responses in Table 6 and Figure 10 showed that the majority of the teachers find it difficult to improvise when it comes

to designing and using TLSMs for effective teaching of Grade 11 Chemistry and Physics and responses of SEO further compliment these findings. In the same vein, the results from follow-up interviews and teachers' live classroom observations showed that majority of the Chemistry and Physics teachers did not use improvised local TLSMs during the their teachings. Thus, the lack of improvisation by the teachers might have a negative impact on the effective use of TLSMs in teaching Grade 11 Chemistry and Physics because learners will not be exposed to hand-on or visual practice for better understanding. According to Abodelraheem and Al-Rabane (2005), and Udosen (2011), the creation of improvised media of low technological materials and the use of resource-centred learning are the paramount exercises in effective teaching.

For clarification, improvisation means using whatever is available because one does not have what is really needed (Namtwi, 2018). This entails that the Chemistry and Physics teachers should use locally accessible materials to teach the subjects and make the contents more understandable to the learners. Remarkably, Aloovi (2018) supplemented by explaining that through the process of adaptation, the teacher should have the knowledge on how to improvise by personalizing the text in the textbook, making it a better teaching resource and individualizes it for a particular group of learners.

The findings from the teachers and SEO questionnaires revealed that there were scarcities of TLSMs in schools in the study area. The findings from follow-up interviews and live classroom observation also showed that the Chemistry and Physics teachers in Kavango East Region experienced scarcity of TLSMs which are

needed for them to teach the contents effectively. The situation of not having adequate TLSMs made some of the teachers not to do practical activities and depend more on theoretical teaching using the teacher-centred teaching method and neglect the recommended learner-centred teaching method. The results correspond with report from the study conducted in Ghana by Adu-Gyamfi (2014), which revealed that science materials and equipment were scarce in schools and where they were available; they were insufficient for effective science teaching and learning. According to Eksi (2014), schools should be provided with TLSMs for teachers to use these materials and tools during science teaching to attract the attention of the students and increase the effectiveness and efficiency in science education. Likewise, Abebe and Davidson (2012), Mathew and Alidmat (2013), and Akasha (2013) believe that teachers should be provided with relevant teaching materials and visual sources to aid the teaching of subject contents to be understood better by the learners. Notably, the availability of teaching-learning resources is important for effective science teaching to take place in the classroom (Likoko, Mutsotso, & Nasongo, 2013).

Furthermore, the results from interviews indicated that overcrowding is another factor hampering effective teaching of Grade 11 Chemistry and Physics using the TLSMs in the study area. The large numbers of learners in a classroom made it impossible for TLSMs to go round the learners and thus, affect effective teaching of Grade 11 Chemistry and Physics concepts. In a similar study, Folashade and Aiknbobola (2009) reported that overcrowdings of classrooms have an undesirable effect on the learners' results in science, because teachers cannot engage and assist all the learners when using materials during the teaching process. Moreover, the

teacher-learner ratio in secondary schools in Namibia is 1:35 (Education Management Information System, 2016). The results of the study are consistent with the results of the studies by Davila (2019) in which the authors revealed that teaching in an overcrowded classroom is stressful, and disheartening. In the same vein, Meador (2019) stressed that overcrowded classrooms in schools have sadly become the new normal, noting that a mixture of an increasing population and a decrease in funding has caused class sizes to soar, and it presents challenges that can feel nearly impossible to overcome, even to the most effective teachers. Makielski (2018), stressed that learners tend to learn effectively when the teacher can offer one on one instruction or teach a small group of learners. Emery (2012) conducted studies on factors affecting the teaching of secondary school subjects and concluded that in most African countries, effective teaching is hampered by the problem of overcrowded classes which also have direct consequences on the learning outcomes.

The results from the follow-up interviews revealed that poor English as a second language (ESL) amongst the science learners have negative impact on teachers' uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area. This means that the use of TLSMs by the teachers may not lead to effective teaching and learning outcome as learners will not understand the subject contents taught in ESL. This result corroborates the study report by Olivier (2011), where it was outlined that in a country like Namibia, particularly in the northern regions where school teaching and learning support are poor, it becomes problematic for learners to use ESL. As noted by Matjila (2004), learners understanding and performance in certain subjects might be affected by the medium of instruction used in the teaching and learning process.

It is also clear from the interview results that the lack of workshop on practical use of TLSMs is one of the constraints to teachers' uses of TLSMs for effective teaching in the study area. Both the questionnaires and follow-up interviews results of the teachers revealed that workshops are not conducted to train teachers on how to create and use TLSMs in Grade 11 Chemistry and Physics. Unfortunately, not every teacher has the knowledge on how to come up with materials and use them in the classroom effectively. Thus, workshops are vital for Chemistry and Physics teachers in the current transformation of education system in Namibia as workshops can provide helpful opportunities for the teachers to gain relevant experiences, and learn from their more experienced colleagues on what works best in teaching the subjects, and in dealing with related challenges. From the social constructivist theory perspective, Akpan et al. (2020) see learning as a social activity associated with other human beings like the peers, family members as well as casual acquaintances, including the people who existed before and are more experienced, and recognizes the social aspect of learning through conversation, interaction with others, and the application of knowledge. Additionally, the workshops will be useful as some teachers left universities several years back and need refresher courses through workshops to update their subject contents knowledge to suit the current new education, which are necessary for Chemistry and Physics teaching. Pande (2013) and Fatiloro (2015) in their studies about problems and remedies in teaching established that workshops help teachers with new ideas and strategies of teaching their subjects. In a study on the impact of teachers' training on students' learning and organizational performance, Ali and Hamza (2018) noted that teachers' trainings help teachers to adopt new teaching techniques and methods, and help teachers to change students'

learning attitude positively which ultimately improve their academic performance. According to Whitby (2010), teachers need workshops to refresh their insight and abilities on educational modules, brain science, and instructional methods, as well as in undertaking new research on instruction and learning in their areas of expertise.

The findings from live classroom observations was clear that the teachers used audible and simple scientific languages to deliver their lessons in striving towards effective teaching and learning of Grade 11 Chemistry and Physics in the study area. Despite the SEO's disagreements on teacher's commitment, during classroom observation, it was observed that teachers are committed to their tasks of using the available TLSMs for effective teaching of Grade 11 Chemistry and Physics. It was also observed that teachers' gives the topic tasks on printed materials and provide corrective feedback on the chalkboard for learners to copy.

4.5 Research Question Three

What are the views of the Chemistry and Physics teachers and SEO on the use of different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?

In answering this research question reference were made to sections; 4.5.1 and 4.5.2; Table 10; Figures 15, 16 and 17, including excerpts from the interviews.

4.5.1 Findings from the Descriptive Analysis of the Views of Chemistry and Physics Teachers and SEO on the use of Different TLSMs

4.5.1.1 Exposing the learners to scientific concepts

Table 10: Teachers' rationale of using TLSMs in teaching Grade 11 Chemistry and Physics lessons

Participants	Responses
Teacher A_1	*I feel that the use of TLSMs plays a significance role in teaching Chemistry and Physics. Learners need to be exposed to practical concepts for them to have a strong foundation and mastering the different concepts in Chemistry and Physics. For examples, learners get excited when they are handling instruments and make use of the laboratory rather than always remain in classes.*
Teachers B1	*To help learners develop an interest in science, to help learners grasp intended knowledge and concepts, and to create or develop a lasting impact in the mind of the learners.*
Teacher C_1	*Learners needed to discover. Chemistry and Physics are pure sciences and learners needed to see how things happen and discover how and why things happen.*
Teacher D_1	*The teaching of Chemistry without doing the practical activities is meaningless. As a teacher I always get available resources to do some practical either by demonstration or learners to carry out the task.*
Teacher E_1	*The materials made teaching and learning tasks easier for both teachers and learners.*
Teacher F_1	*To help facilitate/compliment learners understanding since science is about working with evidence. For effective learning to take place and enhance their cognitive and critical thinking.*
Teacher H_1	*To ensure support in teaching and learning. To add value to my lesson planning, thus aiming for quality education. To expose learners and ensure there is significance increase in their final year achievement and prepare them for tertiary education.*
Teacher I_1	*It is very important because for instance, Physics that I teach; it ought to be a practical field.*
Teacher J_1	*Makes theory to be concrete.*
Teacher J_2	*Learners learn or grasp content well when they see teaching support materials e.g. through the experiments, it saves time and simplify teaching and learning when they learn by doing.*
Teacher K_1	*It boosts better understanding of learners on the science topics learners are taught.*
Teacher L_1	*Provide syllabus to learners to follow as we progress from topic to topic. Help learners to acquire quality knowledge construction. To arouse learners' attention to concentrate more during my lesson.*
Teacher M_1	*To improve the teaching and learning of the subject.*
Teacher M_2	*I divide the chalkboard into four sections to help me provide different tasks to the learners.*
Teacher N_1	*When I download some videos and project them in the lab, learners*

	can easily understand.
Teacher O_1	*To lead learner-centred lessons. To encourage learners' maximum participation in class lessons. To promote peer learning. To develop application skills and interest of learners in science.*
Teacher P_2	*To make information easy to understand, what they see, they do not forget, to stimulate learning and improve teaching effectiveness.*
Teacher Q_1	*It helps learners to deeply understand the concepts as learners will be able to see things and become independent thinkers to practice answering questions.*
Teacher R_1	*I use TLSMs to attract the attention of my learners. In addition, they acquire quality knowledge.*

The results (Table 10) revealed that the participants mainly expressed the views that TLSMs are necessary tools for exposing learners to scientific concepts since Grade 11 Chemistry and Physics are practical-oriented subjects.

4.5.1.2 Enhancement of learners' interest and attitudes

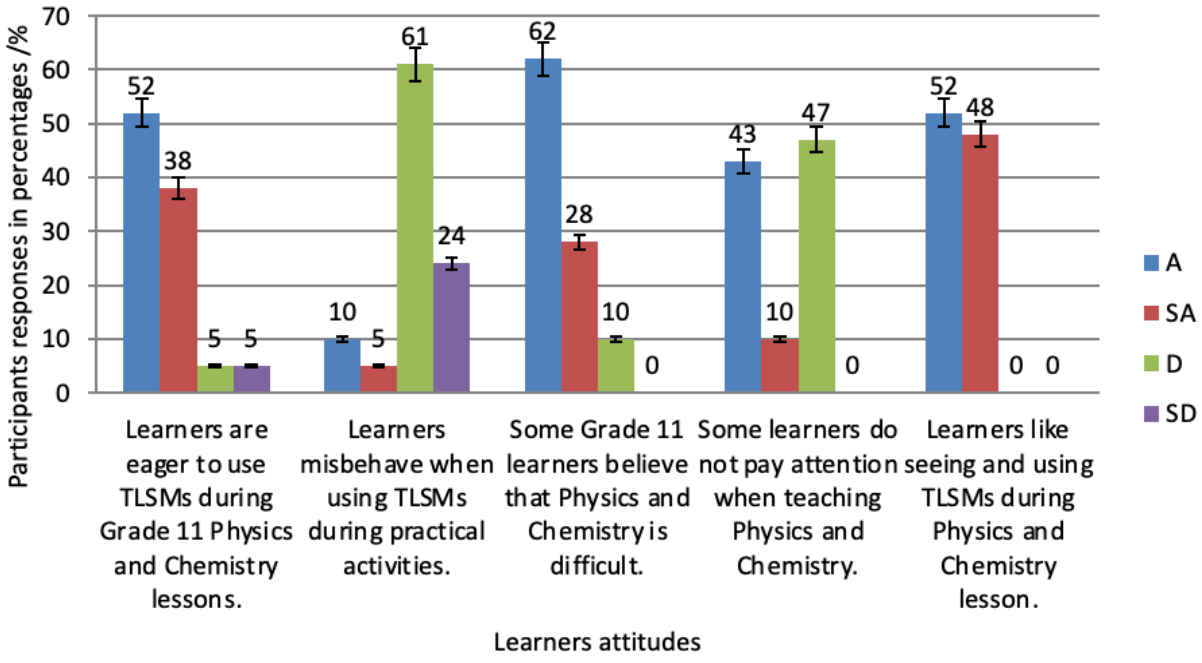


Figure 15: The attitudes of learners with teachers' use of TLSMs in Grade 11 Chemistry and Physics lessons in the study area

The participants also expressed the view that the use of TLSMs for Grade 11 Chemistry and Physics enhances learners' interest and make them develop positive attitudes towards the subjects. As presented in Figure 15, 52% of the participants agreed and 38% of them strongly agreed that learners are eager to use the TLSMs during their teaching of Grade 11 Chemistry and Physics. Though some learners believed that Chemistry and Physics are difficult (62% of the participants agreed with the statement), it is interesting that 62% of the participants disagreed and 24% strongly disagreed that learners do misbehave when using TLSMs during practical activities. Furthermore, majority of the participants (52%) agreed and strongly agreed (48%) that the learners like seeing and using TLSMs during the Grade 11 Chemistry and Physics lessons. Based on the results obtained, it can be inferred that majority of the learners' have positive attitudes towards the use of TLSMs during the lessons.

4.5.1.3 Promotion of teacher-learners interaction

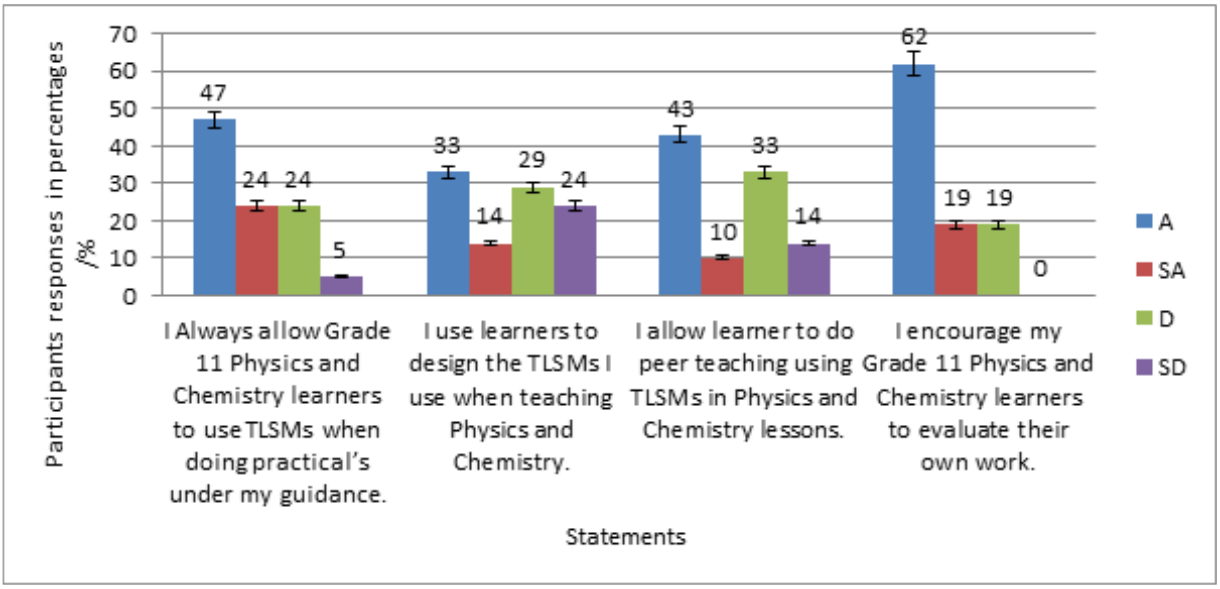


Figure 16: Indicators of teacher-learner interaction when teaching using TLSMs in Grade 11 Chemistry and Physics

The teachers also expressed the view that using TLSMs when teaching Grade 11 Chemistry and Physics is necessary to promote teacher-learner interaction, which could lead to effective teaching of the subjects. As seen in Figure 16, 47% of the participants agreed and 24% of them strongly agreed that that they allow their learners to use TLSMs under their guidance. In addition, the results showed that 33% of the participants agreed and 14% of them strongly agreed that they use learners to design the teaching materials they use when teaching Grade 11 Chemistry and Physics contents. The results also revealed that 43% of the participants agreed that they allow their learners to do peer teaching using TLSMs materials in Grade 11 Chemistry and Physics lessons.

Findings from the followed-up live classroom observations complemented the results from the teachers' questionnaire and interviews. The findings suggest that most teachers encouraged their Grade 11 Chemistry and Physics learners and involved them in the teaching and learning processes using TLSMs.

4.5.1.4 Provision of learning support materials to learners

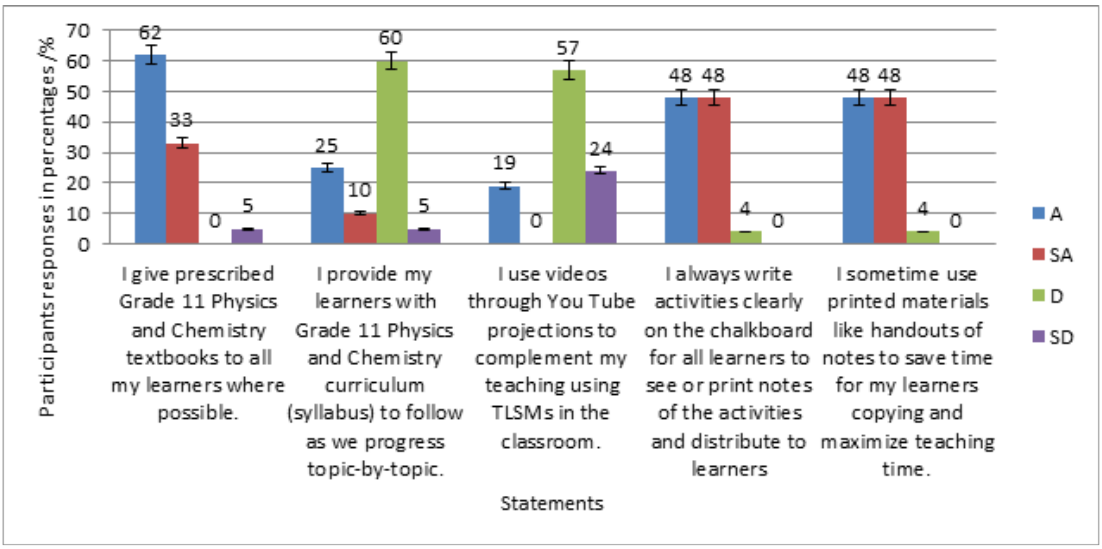


Figure 17: Teachers' provision of TLSMs to Grade 11 Chemistry and Physics learners

The teachers expressed the view that the use of TLSMs in teaching Grade 11 Chemistry and Physics enabled them to provide the desired learning support materials to their learners. The findings (Figure 17) revealed that majority of the participants indicated that they provide learning support materials in the form of prescribed textbooks (62%), printed note (48%), and syllabus (25%) to their learners, while 48% each agreed and strongly agreed that they write activities clearly on the chalkboard.

The results might be influenced by the normal system of the Ministry of Education Arts and Culture's (MoEAC) provision of textbooks, syllabi and chalkboard as TLSMs to schools. However, the results showed that most teachers do not give copies of syllabus to their Grade 11 Chemistry and Physics learners to follow as they are teaching. This might be due to lack of photocopying machines and photo copy papers as observed in several schools during the study. The findings indicated that the teachers used to give learning support materials to their Grade 11 Chemistry and Physics learners in different ways with intention of achieving effective teaching.

4.5.2 Findings from the interviews

4.5.2.1 Teachers experiences of using TLSMs when teaching Grade 11 Chemistry and Physics

During the interviews, the teachers were asked to share their experiences on using TLSMs for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region. The excerpts from the interviews were given below:

Teacher H1 remarked:

> *Teaching resources or materials expose learners to real-life objects and makes learning of Chemistry and Physics real. When learners are doing the practical using teaching and learning resources, it tends to be fun to them, especially when they are doing that on their own in the school laboratory. It also stimulates what the learners have learned previously and integrates what they see and what they learn. Teaching and learning resources also relieves science learners from anxiety or fear, yes; because if we just keep telling them but we are not doing the experiment, they tend to have that fear, but if they do it on their own, they get exposed and that fear or anxiety, and boredom would disappear. For sure, this can lead to effective teaching of Grade 11 Chemistry and Physics.*

In the same vein, Teacher J2 remarked:

> *It helps learner's curiosity about the world and enhances scientific thinking. TLSMs enable both teachers and learners to interact more and participate actively and effectively in lesson sessions of Chemistry and Physics. Therefore, quality and effective teaching and learning can be achieved.*

Teacher M2 remarked:

> *Teaching and learning resources can significantly improve learners' achievement by supporting learner's learning. For example, a worksheet may provide learners with important opportunities to practice a new skill gained in class.*

Teacher L1 remarked:

> *My experience is that one needs to be careful on the choice of TLSMs for effective teaching of Chemistry and Physics. For example, when using consumable such as chemicals, one needs to use these materials sparingly so that the learners do not exhaust all of them in just one class but ensure that they are available to teach other learners too. However, there are other TLSMs that are not consumable, e.g., if you are using a projector and you have PowerPoint slides that you are presenting, you can have your whole time and learners can be exposed, even with videos. That is the effective usage of different teaching and learning materials for effective teaching of Grade 11 Chemistry and Physics contents.*

Moreover, Teacher Q1 remarked:

> *I believe that the use of different TLSMs to teach Grade 11 Chemistry and Physics makes the teaching process more effective and also helps the learners to have a deeper understanding of concepts. However, what I feel like in our region, most of the schools do not have TLSMs to teach Chemistry and Physics effectively. And this is the challenge we are faced with during teaching. So, these make it hard now for us Chemistry and Physics teachers to carry out our lesson on daily basis effectively using these materials. Like*

the lesson involving practical, it makes it hard for us to really carry out these practical with our learners as there are no teaching and learning materials.

Teacher R1 remarked:

As a subject teacher, you must have a lot of teaching and learning materials to help you when delivering the lesson. The teacher will have more knowledge and also handle the lesson with confident because you have different teaching and learning materials. But in our case with Chemistry, to tell you the truth, it is the opposite in terms of using materials.

Teacher R1 remarked:

Due to the scarcity of TLSMs, what I normally do is to prepare my teaching materials by using past question papers where I have to get questions for activities and also compile notes which I normally get on YouTube where I can get some notes especially for practical. I don't have the concrete materials in our school laboratory and I don't use them at all. But I know teaching and learning materials can make a lesson better. The reason why Chemistry and Physics are regarded as a difficult subject is because of the limited teaching and learning materials in our region. With the help of these materials, teaching will be more effective to Chemistry and Physics learners.

Teacher Q1 remarked:

It is really a challenge as the materials are scarce; I hardly use TLSMs on daily basis when I am teaching and at times, I only put few supporting materials in some few lessons where I see that there is a need to use support materials. I use to get help from my colleagues from the nearby schools; there at least, I can organise one practical lesson for my learners so that I can just expose and engage them. In addition, if we don't have the materials

to engage learners in physical activities but they can see videos and posters, and visualize how it is being carried out for practical, then, at least it will really help a lot. So, sometimes I use posters where I design a certain concept, let's say how to test for acid and base in Chemistry. On this, I outline the steps or procedures on how it can be done to carry out this practical. In short, that is how I use to do it with the little resources available. However, the use of teaching and learning support materials makes teaching of Chemistry and Physics more effective. It helps the teacher to have a better interpretation and appreciation of both the concept and subject contents matters. It also helps learners to move towards concrete learning. I believe when learners are exposed and they acquire concrete learning, the learning will really remain in their mind for a longer period of time compared to just carrying out theory.

Teacher F1 remarked:

TLSMs are very good and can make the teaching and learning of Chemistry and Physics more effective where the school is having resources. For example, if we talk about parallel and series circuit in Physics, a school which is having resources and those teaching and learning materials are there, learners can quickly see the difference between parallel and series circuit. What will happen to the series circuit if one bulb got fused or one bulb is not working and what will happen to the parallel circuit; I mean to the series and parallel circuit respectively. So, in fact, the answer here is that the teaching and learning materials make teaching and learning of Chemistry and Physics more effective and realistic. But, now as you know with this COVID-19 that came in, things have changed our teaching dynamic and

methods to be exam oriented teaching now. So, like me now, the materials that I am using are old question papers. I go to the extreme to take question papers from the Cambridge University. So, just to drill the kids for examination and then where practical is required, I will go to paper three. Those are the things I mostly tackle in trying to do practical activities because now, we don't have enough time for practical. We have wasted a lot of time when this COVID-19 pandemic was ever going up. Last year again, the COVID-19 lockdown and so on hampered us a lot. Yes, we are trying but myself, I am using materials where they were supposed to be used like exam related question papers, and a few cases where you bring in concrete materials. Like if you are teaching properties of magnetism, you bring in magnets, and other materials like voltmeter and ammeter yaa, those things that I can easily access. Yaa, but on the other hand, again by exposing kids to YouTube, the fortunate ones when they go home they can download and check the topic that we were doing on the YouTube, yaaa just like that.

Teacher H1 remarked:

What I do mostly, I made copies from the teachers' book because there are no enough textbooks. Then, from there I just make copies for the learners. And also I got summary from one of the teachers and use mostly.

Teacher L1 remarked:

In Chemistry and Physics, there are few areas or topics where perhaps learners use their own understanding of the contents. So, the use of TLSMs helps the learners to understand what is happening. Since these are science subjects which require scientific skills from the learners. So, the use of TLSMs helps learners to understand. Mostly I am using textbook as a

teaching and learning material. Yes, you will have chalkboard; you will have a few lab equipment, and textbooks in that line but in teaching and learning every day, only one or two of these materials are being used.

Teacher J1 remarked:

In teaching here, I use some books and I don't use the lab every time, though I try to always use it.

Teacher O1 remarked:

Chemistry and Physics are quite complex subjects. So, when we use TLSMs, they make it more interesting. So, learners enjoy the activities they are doing and try to understand better. They get exposed, have fun, and then grasp the whole concept and this makes the learning of Chemistry and Physics fun and enjoyable and the acquisition of knowledge is much more effective. Chemistry and Physics subjects are practical subjects that require learners to do hands on activities to enforce some contents into their mind.

Teacher M1 remarked:

Yes, I use teaching materials, like the printed notes that I showed you today. That is the one material that I am using for teaching Grade 11, and also I have a booklet that I am using. So, I used those materials whenever I am teaching. Due to scarcity of materials, now we have to source for teaching materials ourselves, we go online and source for materials. But this is really challenging because sometimes those things that you get online might not be of the standard of our learners. You know sometimes as a teacher, there might be areas that you do not understand properly and cannot explain the concept in Chemistry and Physics. But if you are using YouTube and they are

explaining it nicely, the learners will be able to understand, and this makes teaching and learning more effective.

The SEO remarked:

For example, when we talk of using the voltmeter and ammeter, the only effective way is to first of all design a worksheet. Worksheets on electricity or on resistance have procedure or methods to follow by a learner to carry out the activity. The procedures for observation, recording and conclusion should be clear to learners for them to be able to use TLSMs when available. If the learners are able to master the ways, procedures and methods as outlined in the worksheet, they are likely to follow well and use the TLSMs during practical lessons. Giving the learners worksheet and not just theoretical or verbal instruction on how to conduct an experiment helps them a lot and enable them to follow the procedures and sketches in worksheet to carryout experiment. In addition, this worksheet should contain instructions in simple scientific language which is understandable to all the learners and enable them to adhere to the scientific terminologies at all times.

4.5.3 Discussion of the results on research question three

The participants expressed the views that using TLSMs help learners to be exposed to scientific concepts which assist them to have a strong understanding and mastery of Chemistry and Physics. It is very important for Chemistry and Physics teachers to use TLSMs in their teachings so that learners see how scientific processes take place, and discover how and why such processes happen the way they do. The results also showed that the teachers viewed that using TLSMs help to facilitate learners understanding since science is about working with evidence. Learners should be able

to direct and adapt the activities according to the questions which emerge from their own experiences as it encourages them at various stages of the inquiry to "predict, explain, explore, observe and explain (PEEOE)" their actions (Maselwa & Ngcoza, 2003). These are necessary for the development of learners' cognitive and critical thinking skills which boost understanding of Chemistry and Physics concepts.

Furthermore, the participants expressed the view that learners exhibited positive attitudes when the teachers used TLSMs in teaching Grade 11 Chemistry and Physics and they were eager to participate in lessons. Interestingly, it was found that the teachers allowed their learners to use the available TLSMs during their lessons which could promote learner-teacher interaction and motivate them (learners) to develop positive attitudes towards the subjects. As noted by Swan and Fisch (2010), attitudes usually lead to positive or negative behaviours, and the attitudes of learners toward learning are important in determining their level of performance. In their study Menekse, Stump and Krause (2013) maintained that the involvement and engagement of learners in lessons is the main idea of effective teaching and shaping learners' attitudes in a positive way. Moreover, teachers have to be a guide in the skill development and competencies of their learners through interactions during the lessons to strengthen significance learning, to seek a connection between their learners and science context (Margot & Kettler, 2019).

The participants also viewed that the use of TLSMs like YouTube when teaching Grade11 Chemistry and Physics helps learners to explore the knowledge independently and act as a source of knowledge instrument. In addition, the participants viewed that TLSMs generally add value and structure to both planning

and lesson delivery in the teaching of Grade11 Chemistry and Physics. It can be noted that the use of YouTube during teaching of Grade 11 Chemistry and Physics can help learners to be exposed to some practical activities which might be impossible to carryout due to lack of TLSMs in schools. In a different study, Havlik (2014) alluded that in a polymer chemistry module, students were given the option to make a YouTube video instead of writing a magazine-style article, and noted that students who made videos (YouTube) found it more enjoyable than those who wrote articles and also gained further educational benefits like developing public engagement and presentation skills, enhancing their scientific creativity, and even becoming empowered as global science educators in their own right. The use of video technology in teaching can enhance student learning when teachers use YouTube videos directly as a part of instruction to introduce new concepts and to explain concepts during main or end of instruction (Koto, 2020). Accordingly, this is true as Matzat and Vrieling's, (2016) were of the view that in the modern teaching, teachers rely on YouTube to clarify concepts in lessons they find challenging and to enhance their science instruction deliveries to their learners. Moreover, visual aids like YouTube arouse the interest of learners and help the teachers to explain the concepts easily to learners' understanding (Shabiralyani, Hasan, Hamad & Iqbal, 2015). Likewise, Nakanyala's (2015), substantiated that innovative teaching approaches involving the use of YouTube as teaching support resources made science classes more interesting and lead to better understanding of concepts.

4.6 Research question Four

How can the Chemistry and Physics teachers be supported to improve their uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region?

In answering this research question reference were made to sections; 4.6.1, including excerpts from the interview.

4.6.1 Findings from the interviews

4.6.1.1 Provision of in-service training for Chemistry and Physics teachers

During the interview, the participants identified the need to provide in-service training to the Chemistry and Physics teachers in the Kavango East Region to enhance their uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics. The excerpts from the interviews were presented below.

Teacher L1 remarked:

> *In-service training should not just be for subject content; it should also cover practical uses of TLSMs. For example, if we have more skills and experience in practical activities, and if we are trained well in practical activities, then, setting up practical activities even with the few materials wouldn't be a problem because we know how to use them. Sometimes, they just increase the chemicals as they want, but the practical knowledge you are testing will not work out as the teachers lack usage skills. If we get more experience with the little things, we can teach learners to understand better. So, we need training to conduct experiments.*

Teacher J2 remarked:

> *The government and regional office should give opportunities to Chemistry and Physics teachers to benefit from professional development by funding their studies. Also, the regional office should grant the teachers study leaves. We need to upgrade ourselves in terms of scientific skills to understand what we are doing. We can't end at Bachelor degree; we need at least Masters; this new curriculum is very demanding; I am telling you. So we need to upgrade our knowledge, and we can only get such knowledge through further studying. We can read books but further studying would be more advantageous than just reading it on your own, like what Mr. Shifafure is doing.*

4.6.1.2 School Laboratory

During the interview, some participants including the SEO identified that school laboratories need to be properly equipped to enable teachers to effectively use TLSMs to teach Grade 11 Chemistry and Physics in the study area. The excerpts from the teachers and SEO's interviews were presented below.

Teacher H1 mentioned that:

> *I think the school laboratory should be properly equipped with all necessary apparatus that is stipulated by the syllabus. Yaa, sometimes you would want to follow the syllabus to do practical activities for the learners but the materials are just not available at schools. Then, you end up not doing the practical anymore.*

Teacher J2 remarked:

I don't have a well-established laboratory at our school. These also contributed to my not using the teaching support materials most of the times.

Teacher J1 remarked:

We are having a lab at our school but the materials are not available, not even in the local environment. As a result, most of the learners could not perform well in Chemistry and Physics because the teachers do not have the necessary materials to teach them as prescribed by the syllabus. So, sometimes we try to use any local materials which can fit in the things that we can do. Really, our region needs improvement in this area.

SEO remarked:

The lack of TLSMs is a stumbling block in our schools. Some schools have laboratories but they have turned them into store rooms for sports attires and netball. The lack of well-equipped laboratory for sure is a major problem for the science teachers. Overall, our schools do not have the well-equipped laboratory, making it even more difficult for our teachers' implementation of the revised Grade 11 Chemistry and Physics curricula.

4.6.1.3 Support services to Chemistry and Physics teachers

During the interview, both the teachers and SEO identified the need to provide support services to the Chemistry and Physics teachers to enhance their capabilities for the usage of TLSMs for effective teaching of the subjects in Kavango East Region, Namibia. The followings are the excerpts from the interviews:

Teacher F1 remarked:

Both the Advisory services officer and Regional office should have regular meetings with the teachers teaching those subjects for capacity building. From there, the teachers will give their suggestions and the problems that they are facing. So, what I will suggest is just for the Regional office to get into direct contacts with the schools at least, twice a year or even three times per year: Maybe, at the beginning of the year in the first term and in the last term.

Teacher H1 remarked:

I want the Regional office to plan more workshops to train the science teachers on how to do experiments so that we can also gain confidence, and when we are going to do experiment with the learners, we are also confident about it and know what we are doing in Chemistry and Physics classes. Also, the Ministry of Education should supply the schools with enough textbooks so that each learner at least, in Grade 11 can make use of the textbook during the weekend or after school at home. Like me who is teaching at school which has no hostels, it's really a challenge. Sometime, you want to tell learners read on page this and that, but the books are not enough because one book is shared by four learners.

Teacher J1 remarked:

I would suggest that the Ministry of Education or Regional office should make sure that each school has an established lab, a functional photocopying machine, and an internet access. So, with those things, they can compromise any other things that might not be readily available at school. Because, with the internet you would be able to search for anything that you would want. And if you are having a photocopy machine, you will be able to make copies

from what you researched and give them to learners to learn. But now if there is nothing like that, at least, there should be textbooks, although, textbooks are taught theoretically and these learners would not be able to see anything from there.

Teacher M1 remarked:

Number one, they have to equip the lab, the lab is very important. So, they have to make sure that the chemicals needed in the lab are there. They have to make sure that all the necessary apparatus are in the lab, yes. Learners must see, when we talk about the pendulum, the learners must see how you are doing it. If we talk of the thermometer, learners must see the thermometer, the circuit board; learners must see the electrical circuit board.

Teacher O1 remarked:

The number one thing is the schools should be provided with enough Teaching and Learning Support Materials.

Teacher Q1 remarked:

I believe that our government at large should really look into this matter especially, for teachers teaching Chemistry and Physics. They should make it a must that they buy a lot of equipment and send to various schools. I believe it should not be only with Grade 11, but it should also start from the primary; from Grade 5-7 there. Learners respond well at earliest stage. So, when they come to higher Grades, at least they are already exposed. They will not panic when they are in Grade 11. So, I think in that way, they will do justice.

SEO remarked:

First of all, workshop is number one. We need to conduct workshops for the teachers, like this year, I conducted five workshops to empower teachers on how they can use

those materials. You can first show them, and establish some groups where you combine circuit so that you meet with the teachers to do demonstration. Those ones who do not know or the novice teachers who come directly from tertiary institutions or from the universities can also learn from the experienced teachers during such group meeting. You can demonstrate with some materials so that the teachers know how they could be used. For example, one area that I help the teachers on how to use materials was on titration. Here, the issue of the false zero, meniscus, and how they can read the burette were fully demonstrated. You find that there are some teachers who are really struggling unless you showed them how to do these things. Furthermore, there should be involvement of the manual. Yes, we have the regional manual which is tailored according to the situation of the region.

Secondly, you can also solicit materials from tertiary institutions. For example, the University of Namibia (UNAM), Namibia University of Science and Technology (NUST) and International University of Management (IUM); we can solicit some teaching and learning materials from them. Even the companies which have some projects in the communities can be approached for such help. So, we should have partnership with them so that they can even sponsor some schools with materials. We have lodges in the Kavango East Region and if one can even write letters to them to provide two gas cylinders, or ask them to provide us with these and those, it will be easier to fund the schools in the areas where they operated.

4.6.2 Discussion of the results on research question four

Responding to the question on how the Chemistry and Physics teachers could be supported to improve their uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region, the participants suggested that in-

service training should be provided to the teachers to build their skills on the usage of TLSMs for effective teaching of Grade 11 Chemistry and Physics. Omar (2014) stressed that in-service training act as a catalyst for teachers' effectiveness, and a way of updating teachers' skills and knowledge for improving teaching and learning which lead to better performance. For teachers to cope with the new challenges and changes in the education world, they should upgrade their skills to master the usage of TLSMs which will have positive impact on effective teaching and learning (Osamwonyi, 2016).

The findings also revealed that a well-equipped school laboratory was identified as a major intervention need that could enhance teachers' uses of TLSMs and hence, effective teaching of Grade 11 Chemistry and Physics. The participants highlighted that some schools do not have laboratory equipment and this constrained the teachers from using TLSMs to effectively teach Grade 11 Chemistry and Physics in most secondary schools in the Kavango East Region. Moreover, the SEO stressed that *"schools in the Kavango East Region do not have well-equipped laboratories making it even more difficult for our teachers to implement the revised Grade 11 Chemistry and Physics curricula".* This finding corroborates Niazi, Asghar & Ali, (2018) assertion that a well-equipped school Chemistry or Physics laboratory helps learners to develop important problem-solving skills necessary for success in their competitive, technological society. The National Association of Biology Teachers (NABT) (2004) describes a laboratory learning environment as a place where students work individually or in groups and make use of scientific process and materials to develop their own explanation of scientific process or phenomena. Niazi, et al. (2018), specified that by using laboratory equipment, learners make use of

science process skills such as manipulation, investigation, experimentation, observation, collection and integration of data which can aid their understanding of scientific concepts. The distinction between laboratory learning and traditional classroom learning according to NABT (2004) is that laboratory learning activities are learner-centered with students actively engaged in hands-on and mind-on activities using laboratory equipment and techniques. Furthermore, science educators typically place great importance on well-equipped laboratory, arguing that scientific knowledge cannot be learned effectively from books; rather, they believe that when students involve themselves in practical activities, they not only acquire knowledge but develop technical skills also (NABT, 2004).

It also emerged that the participants advocated for the provision of photocopying machines and internet access to aid the teachers in accessing and using TLSMs. Additionally, the participants advocated for the provision of advisory support services to guide the Chemistry and Physics teachers on effective use of TLSMs in teaching the subjects. Importantly, the participants identified the need for regular meetings between SEO or Regional office and the teachers to identify teachers' needs and challenges with the use of TLSMs and provide remedy. Furthermore, the participants identified the need for workshops to train Chemistry and Physics teachers on skills to carry out experiments and develop confidence in the practical activities that the teachers carry out with their learners. Moreover, the SEO highlighted the need for the establishment of Chemistry and Physics groups by combining circuits to use TLSMs prepared by experienced teachers, and allow novice teacher to learn certain skills from the more experienced colleagues. From the social constructivist perspective, Dorgus (2015) viewed that as learners (in this case

the teachers) interact with people, the material and immaterial environment, they gain understanding and gather experience which is needed to live successful and functional lives. This might be helpful towards effective utilization of TLSMs and hence, improving the teaching of Grade 11 Chemistry and Physics because the teachers would be able to go back to their schools and apply the experiences acquired during their meetings. Luft, Bang, and Roehrig (2007) stated that experienced science teachers can provide indispensable support to novice science teachers; just as experienced teachers guide students in constructing scientific knowledge, they can also guide novice colleagues to construct meaning about science teaching in the classroom. In addition, an experienced science teacher, specifically, is knowledgeable in issues related to laboratories, the nature of science, safety, and other science-specific topics (Donald, 2009). Furthermore, it was found that support from experienced teachers creates a positive learning and teaching environment and contributes to the effectiveness of new teachers (Dangel 2006). This involves providing assistance such as a response to an expressed idea, not just providing materials and resources for use in the classroom (Dangel 2006). Luft and Roehrig (2006) maintain that simply discussing events and ideas such as the use of a conceptual laboratory or the impact of teaching resources can help a beginning science teacher contemplate the impact of a lesson or strategy and foster professional growth in the subject area. Thus, experienced teachers in general bring about a deep understanding of the field of teaching, which comes from years of purposeful professional development and an on-going dedication to improving their craft (Luft, 2004).

The teachers further suggested that secondary schools in the Kavango East Region should be provided with sufficient textbooks so that each learner will have his or her individual textbook that would enable them to work on homework and practice exercises after school especially, in schools without hostels. Gradana (2017), regarded textbook as one of the many TLSMs that teachers can rely upon in creating an effective teaching of their lessons and may offer a framework of guidance and orientation to teachers and learners alike. This provides confidence and security for an inexperienced teacher who finds adapting to the teaching work challenging especially for tailored work-related courses.

The findings from SEO indicated that there is need to develop Chemistry and Physics manual where guidelines on demonstrations of experiments or activities involving different TLSMs are outlined to assist teachers to conduct experiments at their schools. The development of manual is a great idea as it might contribute to correct usage of TLSMs and effective teaching of Grade 11 Chemistry and Physics contents can be obtained. Enderle and Leeanne (2016) opined that physical science laboratory manual is a hands-on and an interactive laboratory experience which provides demonstrable activities. According to Etiubon and Udoh (2017), a good-quality practical manual can engage students, help them to develop important skills, help them to understand the process of scientific investigation, and develop their understanding of concepts. In addition, practical manual support science effectiveness as well as learning experiences that enable students to get the best out of the subject contents (Etiubon & Udoh, 2017). Thus, adequate facilities and materials with supportive science practical manuals are needed to reduce the burden

of the teacher and to promote sensory receptors of the learner on abstract science concepts (Etim, 2006).

The SEO also suggested that soliciting for TLSMs of Chemistry and Physics from higher institutions such as NUST, UNAM, IUM, and other private companies in the local communities might be helpful towards acquiring the materials needed for effective teaching and learning of Chemistry and Physics. Kim and Ju (2008) observed in a Korean University that staff strongly viewed borrowing and sharing of materials as an important motivator to teaching and learning using materials.

4.9 Summary

This chapter presented and discussed the findings of the study. The findings were presented and discussed based on the research questions that guide the study. Primarily, the finding revealed different ways Chemistry and Physics teachers made use of TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region. It was also clear from the findings that there are a number of factors constraining Chemistry and Physics teachers from using different TLSMs for effective teaching in the study area. In addition, the chapter presented the participants' views regarding the usage of different TLSMs for effective teaching and learning, as well as suggestions on how the teachers could be supported to improve their uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics subjects.

The next chapter presents the summary, conclusions and recommendations based on the results of the study.

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introductions

This chapter presents the summary, conclusions and recommendations based on the findings of this study.

5.2 Summary

This study was conducted to investigate teachers' use of Teaching and Learning Support Materials (TLSMs) for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region.

The study addressed the following research questions:

- In what ways do Chemistry and Physics teachers make use of different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?
- What factors constrain Chemistry and Physics teachers from using different TLSMs so as to effectively teach Grade 11 Chemistry and Physics contents in the Kavango East Region?
- What are the views of the Chemistry and Physics teachers and Science Education Officer (SEO) on the use of different TLSMs for effective teaching of Grade 11 Chemistry and Physics in the Kavango East Region?
- How can the Chemistry and Physics teachers be supported to improve their uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region?

The study population included all the Chemistry and Physics teachers teaching in Senior Secondary Schools, and one SEO in the Kavango East Region. According to the information obtained from the Kavango East Regional Directorate of Education, Arts and Culture (KERDEAC), there are combined 21 Chemistry and Physics teachers teaching in 18 Senior Secondary Schools offering the subjects in the region. Out of the combined 21 teachers 9 are Physics teachers and 12 are Chemistry teachers. In addition, there was only one SEO in the region.

In order to answer the research questions, the study adopted the sequential mixed methods research design which employed both quantitative and qualitative approaches. During the study, the quantitative data was collected using closed-ended questionnaires, followed by collection of qualitative data through interviews and live classroom observations. The quantitative data were analyzed using descriptive statistics and then presented using tables and bar charts while the qualitative data from interviews and live classroom observations were analyzed using the thematic analysis method.

The study found that there are different ways in which Grade 11 Chemistry and Physics teachers in the Kavango East Region use different TLSMs for effective teaching and learning of the subjects. According to the participants (Grade 11 Chemistry and Physics teachers), they used TLSMs in their subjects to instill scientific skills of handling apparatus in their learners, arouse learner's attention to concentrate more during the lesson, and help them to remember what they learned. Moreover, TLSMs allow learners to socialize by interacting with one another using the resources, to help their learners to acquire quality knowledge construction in

Chemistry and Physics and enhance long-term memory of learned concepts which are critical for effective teaching and learning. The different ways that the Chemistry and Physics teachers used TLSMs to teach the subjects in Grade 11 in the study area have been reported to contribute to effective teaching of Chemistry and Physics. The study also found that there are some factors which constrained the teachers from using TLSMs for effective teaching of Grade 11 Chemistry and Physics contents. For example, the teachers identified factors such as lack of pedagogical knowledge in using TLSMs to effectively teach Grade 11 Chemistry and Physics, scarcity of TLSMs, overcrowded classrooms, poor English as a Second language, lack of well-equipped school laboratories and lack of training workshops. Different researchers have also reported that these factors hindered teachers' use of TLSMs for effective teaching of Chemistry and Physics.

The study also established the participants' views on the possible intervention measures that can support the Grade 11 Chemistry and Physics teachers to use TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area. According to the participants, such possible intervention measures include provision of teachers' in-service training through Continuous Professional Development, provision of well-equipped school laboratories, and provision of relevant TLSMs. The participants deemed it fit that if these supports are provided to Grade 11 Chemistry and Physics teachers, then effective teaching through the uses of TLSMs can be realized.

5.3 Conclusions

Based on the findings of this study it can be concluded that the Chemistry and Physics teachers who participated in the study used TLSMs in different ways to teach Grade 11 Chemistry and Physics in the classroom. According to the participants (Grade 11 Chemistry and Physics teachers), they used TLSMs in their subjects to instill scientific skills of handling apparatus in their learners, arouse learner's attention to concentrate more during the lesson, and help them to remember what they learned. Moreover, TLSMs allow learners to socialize by interacting with one another using the resources, to help their learners to acquire quality knowledge construction in Chemistry and Physics and enhance long-term memory of learned concepts which are critical for effective teaching and learning. The different ways that the Chemistry and Physics teachers used TLSMs to teach the subjects in Grade 11 in the study area have been reported to contribute to effective teaching of Chemistry and Physics. However, there are several factors hindering the Grade 11 Chemistry and Physics teachers from using the TLSMs for effective teaching of Grade 11 Chemistry and Physics in their schools. These included scarcity of TLSMs, insufficient Chemistry and Physics textbook, lack of well-equipped Chemistry and Physics laboratories, lack of pedagogical skills on the use of TLSMs, overcrowding classrooms, learners' poor English Second Language backgrounds, and lack of workshops for Grade 11 Chemistry and Physics teachers on the proper usage of TLSMs for effective teaching of Grade 11 Chemistry and Physics.

Furthermore, the participants suggested some mitigation measures which they felt should be put in place in order to address the factors affecting their use of TLSMs for

effective teaching of Grade 11 Chemistry and Physics in the study area. These measures included provision of Grade 11 Chemistry and Physics in-service training through Continuous Professional Development for the Chemistry and Physics teachers to build their skills on how to use TLSMs to effectively teach Grade 11 Chemistry and Physics in the study area Grade 11 Chemistry and Physics. Additionally, the provision of relevant TLSMs to secondary schools in the Kavango East Region for Grade 11 Chemistry and Physics and provision of well-equipped Chemistry and Physics laboratories in the schools by the Ministry of Education Arts and Cultures.

5.4 Recommendations

In order to improve Grade 11 Chemistry and Physics teachers' uses of Teaching and Learning Support Materials for effective teaching of the subjects in the Kavango East Region of Namibia, the following recommendations were put forward:

- It is recommended that Grade 11 Chemistry and Physics teachers should incorporate more practical laboratory activities with the lesson in some of the topics to expose learners to experimental techniques and handling of apparatus.
- It is recommended that the SEO should convene workshops more regularly based on innovative usage of TLSMs to help Grade 11 Chemistry and Physics teachers to effectively teach the subjects in the study area.
- It is recommended that SEO should organize school visits to see how teachers are teaching using TLSMs, identify problems faced by the teachers when

using TLSMs in schools and develop targeted intervention measures to support the teachers on the usage of these materials. .

- It is recommended that the Regional Office and Ministry of Education Arts and Culture should provide adequate relevant TLSMs as well as equip Chemistry and Physics school laboratories in school to avail teachers the needed TLSMs for effective teaching of Chemistry and Physics in the study area.

Furthermore, the use of TLSMs would provide the teachers with an interest and compelling platform for conveying Grade 11 Chemistry and Physics contents since they motivate learners to learn. In addition, TLSMs in Grade 11 Chemistry and Physics would assist the teachers in overcoming physical difficulties that could have hindered the effective presentation of a given topic. Moreover, TLSMs during teaching of Grade 11 Chemistry would help teachers to achieve the learning objectives, deliver the lesson, and communicate with learners, to visualize abstract courses and to facilitate effective teaching and learning process. Overall, TLSMs in teaching Grade 11 Chemistry and Physics plays an important role as they fully assist teachers to facilitate teaching, catches learners' attention, motivates Grade 11 learners to learn Chemistry and Physics, support valuable input and authentic scientific language which makes learning of Grade 11 Chemistry and Physics more concrete and more understanding of the concepts.

5.5 Future Research

This study was conducted only in secondary schools in the Kavango East Region of Namibia. For that reason, the results of this study may not be inclusive for all the regions in Namibia. Therefore, similar study should be replicated in secondary schools offering Grade 11 Chemistry and Physics across other regions of Namibia to generate country-wide data that can be used to collectively to improve teachers' use of different TLSMs to achieve effective teaching of Chemistry and Physics. This will also further inform the Ministry of Education on policies regarding the provision and the use of TLSMs in secondary schools.

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APPENDICES

Appendix 1: Ethical clearance certificate from PGS

UNAM
UNIVERSITY OF NAMIBIA

ETHICAL CLEARANCE CERTIFICATE

Ethical Clearance Reference Number: FoE-DEC100521/05 **Date: 12 May 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: INVESTIGATING TEACHERS' USES OF TEACHING AND LEARNING SUPPORT MATERIALS FOR EFFECTIVE TEACHING OF GRADE 11 PHYSICS AND CHEMISTRY IN KAVANGO EAST REGION

Nature/Level of Project: PhD

Researcher: ANDREAS MURONGA SHIFAFURE

Student Number: 200415123

Faculty: 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
FoE-DEC Chairperson

UNIVERSITY OF NAMIBIA
HIFIKEPUNYE POHAMBA CAMPUS
P/BAG 5507
OSHAKATI
12 MAY 2021
TEL: +264 65 2323000
FAX: +264 65 230006
DEPUTY DIRECTOR: ACADEMIC AFFAIRS & RESEARCH

Appendix 2: Research permission letter from UNAM

CENTRE FOR POSTGRADUATE STUDIES

University of Namibia, Private Bag 13301, Windhoek, Namibia
340 Mandume Ndemufayo Avenue, Pioneers Park
☎ +264 61 206 3275/4662; Fax +264 61 206 3290; URL.: http//www.unam.edu.na

UNAM
UNIVERSITY OF NAMIBIA

26 May 2021

Student Name: Andreas Muronga Shifafure
Student number: 200415123
Programme: PhD Science Education Physics and Chemistry

Approved research title: Investigating teachers' uses of teaching and learning support materials for effective teaching of Grade 11 Physics and Chemistry in Kavango East Region

TO WHOM IT MAY CONCERN

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

Permission is hereby granted to carry out the research as described in the approved proposal.

Best Regards

Dr. Seth J. Eiseb
Acting Director: Centre for Postgraduate Studies
Tel: +264 61 2063414
E-mail: directorpgs@unam.na

Appendix 3: Research Permission Letter from Executive Director MOEAC

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

Mt. Andreas Muronga Shifafure
P. O. Box 1877
Rundu

Dear Mr. Shafafure,

SUBJECT: PERMISSION TO CONDUCT ACADEMIC RESEARCH IN KAVANGO EAST REGION

The Ministry wishes to acknowledge receipt of your letter dated 27 May 2021 seeking for permission to conduct academic research at schools for your PhD studies which is focusing on: *"Investigating Teachers' Uses of Teaching and Learning Support Materials for Effective Teaching of Grade 11 Physics and Chemistry in Kavango East Region."*

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

- the school principals are aware of your presence;
- teaching and learning should not be interrupted;
- participation is voluntary.

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,

Ministry of Education, Arts and Culture
Office of the Executive Director
09 JUN 2021

Sanet L. Steenkamp
EXECUTIVE DIRECTOR

All official correspondence must be addressed to the Executive Director

Page 1 of 1

Appendix 4: Research Permission Letter from RDKE**RMOEAC**

REPUBLIC OF NAMIBIA
KAVANGO EAST REGIONAL COUNCIL

DIRECTORATE OF EDUCATION, ARTS AND CULTURE

OFFICE OF THE DIRECTOR

Tel. (066) 258 9000 / 258 9201
Fax (066)... 267 707
Enquiries: **Juvensia Nyumba**
Ref. No. : 20/10/1

Private Bag 2134
RUNDU
Namibia

Date : 07 June 2021

Mr. Andreas Muronga Shifafure
P.O. Box 1877
RUNDU

Dear Mr. Andreas Muronga Shifafure

SUBJECT: PERMISSION TO CONDUCT RESEARCH IN KAVANGO EAST REGION

Your letter dated 27 May 2021 on the above mentioned bears reference.

This serves to inform you that permission is hereby granted to Mr. Andreas Muronga Shifafure to carry out research study at any School in the Kavango East Region as stated in your request.

However, necessary arrangements should be made with the management of the identified school so that the activity does not interfere with the normal programme of the school and compromise on teaching and learning.

The Principal and management of the identified Schools are therefore requested to accord their usual support.

Yours sincerely,

.....

Fanuel Kapapero
REGIONAL DIRECTOR
KAVANGO EAST REGIONAL COUNCIL

KAVANGO EAST REGIONAL COUNCIL
Directorate of Education, Arts & Culture
2021 -06- 07
DIRECTOR
PRIVATE BAG 2134, RUNDU

07.06.2021
.....
Date

Appendix 5: Informed consent letter to Executive Director MOEAC

Mr. Andreas Muronga Shifafure
P.O. Box 1877
Rundu
Namibia
27 June 2021

The Executive Director
Ministry of Education, Arts and Culture
Private Bag 13186
Windhoek
Namibia

Dear: Sanet L. Steenkamp

RE: TO CONDUCT A PHD RESEARCH STUDY IN KAVANGO EAST REGION

I, Andreas Muronga Shifafure, a Physical Science/Chemistry/Physics teacher at Angelina Matumbo Ribebe Secondary School. I am currently pursuing a Doctor of Philosophy (PHD) in Science Education-Phyics and Chemistry with the University of Namibia and my student number is: 200415123.

This letter serves to request your permission to conduct a study in (*number of schools or sites*) Grade 11 Secondary Schools in Kavango East Region and in Kavango East Regional Office – Senior Education Officer (Advisory Section). The research forms a critical part of the PHD course and it is to be conducted from 01 June 2021 to 30 June 2021, targeting only Grade 11 Chemistry/Physics teachers per selected school and one Science Education Officer.

The approval to carry out this research study is granted from UNAM's Ethical Clearance Committee and the Director of UNAM PGS studies (see attached letters).

The topic of the research is "**Investigating teachers' uses of teaching and learning support materials for effective teaching of grade 11 physics and chemistry in kavango east region"** under the supervision of Associate Prof. J. Abah and Dr A. Shobo. The findings of this study will be shared with the participants, the schools and the Ministry of Education, Arts and Culture. I will personally distribute the questionnaires to all participants and collect them, and later conduct face-to-face interviews for the sub-sampled 10 participants and Senior Education Officer.

I would like to assure you that I will strictly adhere to research ethics. Notably, all the information received from participants will be treated with utmost confidentiality and will entirely be used for the educational purposes.

I am looking forward to receive your speedy favourable response.
Yours faithfully,

Date: 27/05/2021

Mr. Andreas Muronga Shifafure (UNAM, PHD- Science Education-Physics and Chemistry student)

Appendix 6: Informed consent letter to RDEKER

Mr. Andreas Muronga Shifafure
P.O. Box 1877
Rundu
Namibia
27 May 2021

The Regional Director
Kavango East Education Region
Ministry of Education, Arts and Culture
Private Bag 2134
Rundu

Dear Mr Fanuel Kapapero

RE: TO CONDUCT A PHD RESEARCH STUDY IN KAVANGO EAST REGION

I, Andreas Muronga Shifafure, a Physical Science/Chemistry/Physics teacher at Angelina Matumbo Ribebe Secondary School. I am currently pursuing a Doctor of Philosophy (PHD) in Science Education-Phyics and Chemistry with the University of Namibia and my student number is: 200415123.

This letter serves to request your permission to conduct a study in (*number of schools or sites*) Grade 11 Secondary Schools in Kavango East Region and in Kavango East Regional Office – Senior Education Officer (Advisory Section). The research forms a critical part of the PHD course and it is to be conducted from 01 June 2021 to 30 June 2021, targeting only Grade 11 Chemistry/Physics teachers per selected school and one Science Education Officer.

The approval to carry out this research study is granted from UNAM's Ethical Clearance Committee and the Director of UNAM PGS studies (see attached letters).

The topic of the research is "**Investigating teachers' uses of teaching and learning support materials for effective teaching of grade 11 physics and chemistry in kavango east region"** under the supervision of Associate Prof. J. Abah and Dr A. Shobo. The findings of this study will be shared with the participants, the schools and the Ministry of Education, Arts and Culture. I will personally distribute the questionnaires to all participants and collect them, and later conduct face-to-face interviews for the sub-sampled 10 participants and Senior Education Officer.

I would like to assure you that I will strictly adhere to research ethics. Notably, all the information received from participants will be treated with utmost confidentiality and will entirely be used for the educational purposes.

I am looking forward to receive your speedy favourable response.
Yours faithfully,

Date: 27/05/2021

Mr. Andreas Muronga Shifafure (UNAM, PHD- Science Education-Physics and Chemistry student)

Appendix 7: Informed consent letter to Principal of schools Kavango East Region

Mr. Andreas Muronga Shifafure
P.O. Box 1877
Rundu
Namibia
27 May 2021

The Principal
_____
P. O. Box/Private Bag _____
Rundu
Namibia

RE: TO CONDUCT A PHD RESEARCH STUDY AT YOUR SCHOOL

I, Andreas Muronga Shifafure, a Physical Science/Chemistry/Physics teacher at Angelina Matumbo Ribebe Secondary School. I am currently pursuing a Doctor of Philosophy (PHD) in Science Education with the University of Namibia and my student number is: 200415123.

This letter serves to request your permission to conduct a study at your school. The research forms a critical part of the PHD course and it is to be conducted from 01 June to 30 June 2021. The targets are only Grade 11 Chemistry and Physics teachers.

The approval to carry out this research study is granted from UNAM's Ethical Clearance Committee and The Director of Education, Kavango East Region (see attached letter).

The topic of the research is "**Investigating teachers' use of teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics in kavango east region"** under the supervision of Associate Prof. J. Abah and Dr A. Shobo. The findings of this study will be shared with the participants, the schools and the Ministry of Education, Arts and Culture. I will personally distribute the questionnaires to all participants and collect them, and later conduct structured face-to-face interviews for the sub-sampled participants.

I would like to assure you that I will strictly adhere to research ethics. Notably, all the information received from participants will be treated with utmost confidentiality and will entirely be used for the educational purposes.

I am looking forward to receive your speedy favourable response.

Yours faithfully,

Mr. Andreas Muronga Shifafure (UNAM, PHD- Science Education student)
Cell: 0813721385/0813850297 Email: andreasshifafure@gmail.com

Appendix 8: Informed consent letter to participants - Grade11 Chemistry and Physics Teachers and Science Education Officer Kavango East Region

Dear participant

You are invited to participate in a PhD-research project aimed at"**Investigating teachers' use of teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics in Kavango East Region"**. The aim of this study is to explore the uses of teaching and learning support materials used by Chemistry and Physics teachers for effective teaching of grade 11 in the region. As a result, your input and feedback are imperative to the study. Your participation in this study will be; completion of the questionnaire and interview if you will be amongst the selected group of participants for interview.

Although your participation is voluntary, confidentiality will be guaranteed throughout the study, and you may withdraw at any time if you wish not to continue with this study. Please be assured that any information obtained from this study will be used merely for the purpose of this study.
Hence, if you are willing to participate in this study; kindly fill in your particulars in this letter below as declaration of your consent.
Yours in Research,

Mr. Andreas Muronga Shifafure
UNAM, PHD- Science Education student
Cell: 0813721385/0813850297 Email: andreasshifafure@gmail.com

Participant's declaration of consent

I.....…..... (Name) agree to participate in the research entitled "Investigating teachers' use of teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics in Kavango East Region, Namibia" as outlined in the consent letter.

Signature:.....Date: ..... /……/ 2021

Cell:_____Email:_____(optional)

Appendix 9: Questionnaire for Science Education Officer

Introduction

My name is Andreas Muronga Shifafure, a Doctor of Philosophy in Education student at the University of Namibia. I am doing a study on investigating teachers' use of teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics in Kavango East Region. I therefore kindly ask you, as Science Education Officer for Chemistry and Physics, to provide me with relevant information, which will greatly help me in my study. The information that you will provide will be treated confidentially. The purpose of the study is not to judge, evaluate or assess you, it is to help investigate teachers' use of teaching and learning support materials for effective teaching of Chemistry and Physics. You are therefore urged to answer all questions as honestly as possible. If the information you want to write does not fit in the space provided, please feel free to request more paper.

Instructions:

- Do not write your name on this paper
- Please, try to answer all the questions
- Where a choice is needed use a cross, like this: ☒

Thank you

Section A: Biographical Information

1. Gender

Male	
Female	

2. Age

20-29	
30-39	
40-49-	
50 +	

3. Highest qualification

PhD	
M.Ed	
B.Ed	
BETD	
Other (specify) ……	

4. Year in which qualification was obtained

Before 1989	
1990-2000	
2001-2010	
2011 +	

Section B: Teachers made use of different teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics.

1. How long have you been as a Science Education Officer?

Years	
1-5	
6-10	

11-15	
16-20	
21 +	

2. What teaching and learning support materials do you often provide to Chemistry and Physics teachers for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region?
(Name them)

_____
___
_____
___

3. What problems do you think the Chemistry and Physics teachers experience in using the teaching and learning support materials in order to effectively teach Grade 11 Chemistry and Physics?

_____
_____

_____4. Amongst the problems you listed in question 5, which do you consider to be the biggest problems that the teachers' experience using teaching and learning support materials in Grade 11 Chemistry and Physics classroom?

_____
_____
_____

Please for the following questions indicate the extent to which you agree (A), strongly agree (SA), disagree (D), strongly disagrees (SD) with the statements below by putting a cross (x) next to each statement (only in one box per statement).

5. How often do you think Chemistry and Physics teachers should use teaching and learning support materials during their teaching of Grade 11 Chemistry and Physics?

Statement	A	SA	D	SD
5.1 In every lesson I teach				
5.2 Sometimes				
5.3 Only when I want to				
5.4 Not at all				

6. What teaching and learning support materials do you always provide to Chemistry and Physics teachers for effective teaching of Grade 11 Chemistry and Physics in Kavango East Region?

Statement	A	SA	D	SD
6.1 Chalkboard				
6.2 Posters				
6.3 Textbooks				
6.4 Charts				
6.5 Recycled materials				
6.6 ICT (Laptops/Desktop computer/internet/Projectors/ Overhead Projectors (OHP))				
6.7 Printed media (Handouts)				
6.8 Laboratory Chemicals				
6.9 Videos (You Tube)				
6.10 Laboratory scientific Apparatus				

Others (please specify):

_____

___

7. Availability of teaching and learning support materials which the Chemistry and Physics teachers use for effective teaching of Grade 11 Chemistry and Physics at your school.

Statements	A	SA	D	SD
7.1 Teachers have plenty teaching and learning support materials at their schools				
7.2 All our Grade 11 learners have their own Chemistry and Physics textbooks				
7.3 All schools have a well equipped Chemistry and Physics laboratory.				
7.4 Teachers do not have enough materials for doing practical's				

8. The teaching methods Chemistry and Physics teachers are expected to use when they are using teaching and learning support materials for effecting teaching of Grade 11 Chemistry and Physics in your classroom.

Statements	A	SA	D	SD
8.1 teachers-centred method				
8.2 Learner-centred method				
8.3 Practical method				
8.4 Group work method				
8.5 Discussion method				

Other (specify)

_____

___

9. How can you rate the Chemistry and Physics teachers subject knowledge when using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics?

Statements	A	SA	D	SD
9.1 Teachers have adequate knowledge of Grade 11 Chemistry and Physics TLSMs				
9.2 Teachers find it difficult to improvise with local materials when doing practical's requiring chemicals substances in Chemistry and Physics.				
9.3 Teachers use audible tone in simple scientific language to make learners understand Grade 11 Chemistry and Physics Contents.				
9.4 Teachers sometimes find it challenging when referring to real life materials in some chemistry sections.				
9.5 Teachers find it challenging to carry out some experiments outlined in the syllabus as a results of inadequate skills for practical's.				
9.6 Teachers use Chemistry and Physics Examiners reports to effectively teach and assess their learners.				

10. Challenges of teaching Grade 11 Chemistry and Physics curriculum using the available TLSMs.

Statements	A	SA	D	SD

10.1 Grade 11 Chemistry and Physics syllabus do not match with some textbook supplied to schools.				
10.2 Required period in the syllabus and policy of Grade 11 Chemistry and Physics is not reflecting on the teachers' timetable.				
10.3 Inadequate number of Grade 11 Chemistry and Physics teachers at schools to effectively teach the curriculum.				
10.4 Teachers are overloaded with Grade 11 Chemistry and Physics lessons per cycle.				
10.5 Teaching and learning support materials specified in the Grade 11 Chemistry and Physics curriculum is not supplied to schools.				

11. The teacher's commitments when they are using teaching and learning support materials in their teaching of Grade 11 Chemistry and Physics at school.

Statements	A	SA	D	SD
11.1 Teachers manage their time for teaching Grade 11 Chemistry and Physics effectively whenever doing practical activities.				
11.2 Teachers mark all the topic tasks they give to their learners and provide corrective feedback clearly on the chalkboard.				
11.3 Teachers always give a test on printed materials at the end of each and every topic and broad sub-topics in Grade 11 Chemistry and Physics.				
11.4 Teachers always strive to finish their Chemistry and Physics syllabus and scheme of work for on time using the prescribed teaching materials (textbooks).				

12. Please rate the Chemistry and Physics teachers' pedagogical content knowledge when using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
12.1 Teachers use teaching materials to help their learners acquire quality knowledge construction in Chemistry and Physics.				
12.2 Teachers use teaching and learning materials to instill skills of handling of apparatus in their learners in Grade 11 Chemistry and Physics class.				
12.3 Teachers use teaching TLSMs to arouse learners attention to concentrate more during the lesson and help them remember what they will do using the apparatus in Chemistry and Physics.				
12..4 Teachers use TLSMs when teaching to allow learners to socialize by interacting within one another using the resources.				

13.1 Motivation of learners when using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
13.1 Teachers use teaching materials to encourage				

learners learn as they are using hands-on materials.				
13.2 Teachers allow their learners to use teaching and learning materials to develop confidence in their learners when doing practical's.				
13.3 Teachers believe that learners learn at their best when they are using real-life learning materials in Grade 11 Chemistry and Physics.				

14. Practical work using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
14.1 Teachers use improvised teaching and learning materials when doing practical activities with their learners in Grade 11 Chemistry and Physics.				
14.2 The schools are provided with laboratory resources to be used when teaching practical works in Grade 11 Chemistry and Physics.				
14.3 The schools depend on theoretical work than conducting practical work.				
14.4 At school teacher do not do practical work at all.				

Thank you for your time

Appendix 10: Questionnaire for Chemistry and Physics teachers

Introduction

My name is Andreas Muronga Shifafure, a Doctor of Philosophy in Education student at the University of Namibia. I am doing a study on investigating teachers' use of teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics in Kavango East Region. I therefore kindly ask you, as a Chemistry and Physics teacher, to provide me with relevant information, which will greatly help me in my study. The information that you will provide will be treated confidentially and used only for the purpose of this study. The purpose of the study is not to judge, evaluate or assess you, it is to help investigate teachers' use of teaching and learning support materials for effective teaching of Chemistry and Physics. You are therefore humbly asked to attempt all questions as honestly as possible. If the information you want to write does not fit in the space provided, please feel free to write outside the space.

Instructions:

- Do not write your name on this paper
- Where a choice is needed use a cross, like this: ☒

Thank you

Section A: Biographical Information

1. Gender

Male	
Female	

2. Age

20-29	
30-39	
40-49-	
50 +	

3. Highest qualification

PhD	
M.Ed	
B.Ed	
BETD	
Other (specify) ……	

4. Year in which qualification was obtained

Before 1989	
1990-2000	
2001-2010	
2011 +	

5. **Section B: Teachers' use of different teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics.**

1. How long have you been teaching Grade 11 Chemistry and Physics?

Years	

1-3	
4-6	
7-10	
11-15	
16 +	

2. What teaching and learning support materials do you use in teaching Grade 11 Chemistry and Physics?
(Name them)

_____
_____
_____

3. What problems do you experience in using the teaching and learning support materials mentioned in question 2 in your teaching of Grade 11 Chemistry and Physics?

_____
_____
_____

4. Amongst the problems you listed in question 3, what do you consider to be the biggest problems that you experience using teaching and learning support materials in Grade 11 Chemistry and Physics classroom?

_____
_____
_____

5. What are your rational for using teaching and learning support materials to teach your grade 11 Chemistry and Physics lessons?

_____
_____
_____

Please for the following questions indicate the extent to which you agree (A), strongly agree (SA), disagree (D), strongly disagrees (SD) with the statements below by putting a cross (x) next to each statement (only in one box per statement).

6. How often do you use teaching and learning support materials during your teaching of Grade 11 Chemistry and Physics?

Statement	A	SA	D	SD
6.1 In every lesson I teach				
6.2 Sometimes				
6.3 Only when I want to				
6.4 Not at all				

7. What teaching and learning support materials do you use in your classroom for effective teaching of Grade 11 Chemistry and Physics at your school?

Statement	A	SA	D	SD
7.1 Chalkboard				
7.2 Posters				
7.3 Textbooks				
7.4 Charts				
7.5 Recycled materials				
7.6 ICT (Laptops/Desktop computer/internet/Projectors/ Overhead Projectors (OHP))				

7.7 Printed media (Handouts)				
7.8 Laboratory Chemicals				
7.9 Videos (You Tube)				
7.10 Laboratory scientific Apparatus				

Others (please specify):

_____

___

8. Availability of teaching and learning support materials which you use for effective teaching of Grade 11 Chemistry and Physics at your school.

Statements	A	SA	D	SD
8.1 Plenty teaching and learning support materials at our school				
8.2 All our Grade 11 learners have their own Chemistry and Physics textbooks				
8.3 Our school have a well equipped Chemistry and Physics laboratory.				
8.4 Not enough materials for doing practical activities				

9. The teaching methods used when using teaching and learning support materials for effecting teaching of Grade 11 Chemistry and Physics in your classroom.

Statements	A	SA	D	SD
9.1 teachers-centred method				
9.2 Learner-centred method				
9.3 Practical method				
9.4 Group work method				
9.5 Discussion method				

Others (specify)

_____

___

10. The teachers subject knowledge when using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
10.1 I have adequate knowledge of Grade 11 Chemistry and Physics.				
10.2 I find it difficult to improvise with local materials when doing practical activities requiring chemicals substances in Chemistry and Physics.				
10.3 I use audible tone in simple scientific language to make learners understand Grade 11 Chemistry and Physics Contents.				
10.4 I find it challenging when referring to real life materials in some chemistry sections.				
10.5 I find it challenging to carry out some experiments outlined in the syllabus as a results of inadequate skills for practicals.				
10.6 I use Chemistry and Physics Examiners reports to effectively teach and assess my learners.				

11. The attitudes of learners when using teaching and learning support materials to teach effectively Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD

11.1 Learners are eager to use the materials during Grade 11 Chemistry and Physics lessons.				
11.2 Learners misbehave when using teaching and learning materials during practical activities.				
11.3 Some Grade 11 learners believe that Chemistry and Physics is difficult.				
11.4 Some learners do not pay attention when teaching Chemistry and Physics.				
11.5 Learners like seeing and using teaching and learning materials during Chemistry and Physics lesson.				

12. Challenges of teaching Grade 11 Chemistry and Physics curriculum using the available TLSMs

Statements	A	SA	D	SD
12.1 Grade 11 Chemistry and Physics syllabus do not match with some textbook supplied to school.				
12.2 Required period in the syllabus and policy of Grade 11 Chemistry and Physics is not reflecting on the timetable (Double periods).				
12.3 Inadequate number of Grade 11 Chemistry and Physics teachers at our school.				
12.4 I am overloaded with Grade 11 Chemistry and Physics lessons per cycle.				
12.5 Teaching and learning support materials specified in the Grade 11 Chemistry and Physics curriculum is not supplied at our school.				

13. The interaction of teacher and learners when teaching using teaching and learning support materials in Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
13.1 I Always allow Grade 11 Chemistry and Physics learners to use teaching and learning support materials when doing practical's under my guidance.				
13.2 I use learners to design the teaching materials I use when teaching Chemistry and Physics.				
13.3 I allow learner to do peer teaching using man-made materials in Chemistry and Physics lessons.				
13.4 I encourage my Grade 11 Chemistry and Physics learners to evaluate their own work.				

14. The teacher's commitments when using teaching and learning support materials in their teaching of Grade 11 Chemistry and Physics at school.

Statements	A	SA	D	SD
14.1 I manage my time for teaching Grade 11 Chemistry and Physics effectively whenever doing practical activities.				
14.2 I mark all the topic tasks I give to my learners and provide corrective feedback clearly on the chalkboard.				
14.3 I always give a test on printed materials at the end of each and every topic and broad sub-topics in Grade 11				

Chemistry and Physics.				
14.4 I always strive to finish my Chemistry and Physics syllabus and scheme of work for on time using the prescribed teaching materials (textbooks).				

15. Teachers' learning support of teaching and learning materials in Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
15.1 I give prescribed Grade 11 Chemistry and Physics textbooks to all my learners where possible.				
15.2 I provide my learners with Grade 11 Chemistry and Physics curriculum (syllabus) to follow as we progress topic-by-topic.				
15.3 I use videos through You Tube projections to complement my teaching using teaching materials in the classroom.				
15.4 I always write or print notes or activities in clear font on the chalkboard for all learners to see.				
15.5 I sometime use printed materials like handouts of notes to save time for my learners copying and maximize teaching time.				

16. Teachers' pedagogical content knowledge when using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
16.1 I use teaching materials to help my learners acquire quality knowledge construction in Chemistry and Physics.				
16.2 I use teaching and learning materials to instill handling of apparatus in my learners of Grade 11 Chemistry and Physics.				
16.3 I use teaching materials to arouse learners attention to concentrate more during the lesson and help them remember what they will do using the apparatus in Chemistry and Physics.				
16..4 I use materials when teaching to allow learners to socialize by interacting within one another using the resources.				

17.1 Motivation of learners when using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
17.1 I use teaching materials to encourage learners learn as they are using hands-on materials.				
17.2 I allow my learners to use teaching and learning materials to develop confidence in my learners when doing practical activities.				
17.3 I believe that learners learn at their best when they are using real-life learning materials in Grade 11 Chemistry and Physics.				

18. Practical work using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
18.1 I use improvised teaching and learning materials when doing practical's with my learners in Grade 11 Chemistry and Physics				
18.2 Our school is provided with laboratory resources to be used when teaching practical work in Chemistry and Physics.				
18.3 Our school depends on theoretical work than conducting practical work.				
20.4 At our school we do not do practical work at all.				

19. Rational for using teaching and learning support materials (TLSMs) for effective teaching of Grade 11 Chemistry and Physics.

Statements	A	SA	D	SD
19.1 TLSMs help to attract learners' attention during teaching.				
19.2 TLSMs aid the teaching and learning processes by adding structure to lesson planning and delivery of instructions.				
19.3 Printed materials and real life materials activate learners' learning styles which increase their learning and success.				
19.4 TLSMs help learners to explore the knowledge independently and act as a source of knowledge instrument of transmission of Grade 11 Chemistry and Physics contents.				
19.5 TLSMs Promote teachers-learners and learners-learners communication and interaction.				
19.6 TLSMs help to activate, motivate and arouse learners' interests in challenging tasks.				
19.7 TLMs improve the teaching effectiveness in class				
19.8 TLSMs help to make learning more focused, effective, interesting, vivid, meaningful and imaginative.				
19.9 TLSMs stimulate and motivate students to be innovative in learning and application of skills.				

Thank you for your time

Appendix 11: Interview protocol for Science Education Officer

Thank you Sir / Madam

The purpose of this interview is for us to talk about the teachers' use of teaching and learning support materials (TLSMs) for effective teaching of grade 11 Chemistry and Physics in Kavango East Region Secondary school. I would like us to look into what in reality is happening in our teaching in the classroom in secondary school and provide some solution to the following questions. Despite the fact that, there might be some additional or follow up questions.

1. How long have you been the science education officer of the Kavango East Region?
2. Most of state schools in Kavango East Region experience scarcity of teaching and learning support materials (TLSMs). Explain how do you respond to the scarcity of teaching and learning materials during the teaching of Grade 11 Chemistry and Physics.
3. Please share with me your understanding of teaching and learning support materials in Chemistry and Physics?
4. Have you been organizing workshops for the Chemistry and Physics teachers in order to enhance their capacities on the use of teaching and learning support materials to effectively teach grade 11 Chemistry and Physics in the Kavango East Region? Please elaborate.
5. Did the teachers' use of teaching and learning materials responds to the approach of learner-centred approach or not? Please elaborate.
6. Do you think teaching and learning support materials can make the teaching of grade 11 Chemistry and Physics more effective? Please elaborate.
7. What could be the negative or positive impacts of using the teaching and learning support materials during the teaching of grade 11 by Chemistry and Physics?
8. As the only science education in the Kavango East region, kindly share with me your perceptions on the use of different teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics in the region.
9. Name the different teaching and learning support materials you use when teaching Grade 11 Chemistry and Physics?
10. How should the Chemistry and Physics teachers use the different teaching and learning support materials that you named in order to achieve effective teaching of grade 11 Chemistry and Physics?
11. What kind of teacher support services do you provide to the Chemistry and Physics teachers from Head Office to enhance teaching and learning?
12. As the science education officer in the Kavango east region, what support services do you provide to the Chemistry and Physics teachers to enhance teaching and learning?
13. Suggest the strategies Chemistry and Physics teachers can make use of in order be supported to improve the use of teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics in Kavango East Region?

14. How should the Physical science teachers use the different teaching and learning support materials that you named in order to achieve effective teaching of grade 11 Chemistry and Physics?
15. What factors constrain your teaching when using the named different teaching and learning support materials for effectively teaching of grade 11 Chemistry and Physics contents in Kavango East Region?
16. Suggest how do you deal with these factors you have identified
17. In your opinion, what type of teaching and learning support materials can be used more often for effective teaching of Grade 11 Chemistry and Physics contents? And which of the materials will you recommend other teachers to use during their teaching?
18. Suggest how best that the grade 11 Chemistry and Physics teachers can be supported to improve their uses of TLSMs for effective teaching of Grade 11 Chemistry and Physics contents?

THANK YOU

Appendix 12: Interview protocol for Chemistry and Physics Teachers.

Thank you Sir / Madam.

The purpose of this interview is to seek your in depth opinion about the teachers' use of teaching and learning support materials (TLSMs) for effective teaching of grade 11 Chemistry and Physics in Kavango East Region. Kindly share your honest opinion with me on the Chemistry and Physics teachers' use of teaching and learning support materials (TLSMs) for effective teaching of grade 11 Chemistry and Physics in secondary school in the Kavango East Region. The interview is expected to take not more than 50 minutes.

1. Most of state schools in Kavango East Region experience scarcity of teaching and learning support materials. Explain how do you respond to the scarcity of teaching and learning materials during the teaching of Grade 11 Chemistry and Physics.
2. Do you use teaching and learning support materials during your daily teaching of Grade 11 Chemistry and Physics?
3. Please share with me your understanding of teaching and learning support materials in Chemistry and Physics?
4. Did the teachers' use of teaching and learning materials responds to the approach of learner-centred approach or not? Explain your answer.
5. Do you think teaching and learning support materials can make teaching of Chemistry and Physics more effective? Explain your answer.
6. As a Chemistry and Physics teacher, kindly share with me your perceptions on the use of different teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics in the Kavango East Region of Namibia?
7. In your view, are there negative impacts involved in the use of teaching and learning support materials during the teaching of Chemistry and Physics?
8. Explain your first time experiences of teaching Grade 11 Chemistry and Physics using teaching and learning support materials.
9. Have you been attending workshops to build Chemistry and Physics teachers' capacity on the uses of teaching and learning support materials (TLSMs) for effective teaching of grade 11 Chemistry and Physics?
10. Did you receive professional support from your teacher training institution to prepare you on the use of teaching and learning support materials in Chemistry and Physics or science subject? Please elaborate.
11. What support did you receive from Science Head of Department about the use of teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics?
12. What teacher support services did you receive from your Cluster Centre or Kavango East Regional office to enhance your skill on the use of TLSMs in teaching Grade 11 Chemistry and Physics?
13. What support services do you expect to receive about using TLSMs through the cluster centre, and why?
14. Name the different teaching and learning support materials you use when teaching Grade 11 Chemistry and Physics?

15. How do you use the different teaching and learning support materials that you named in order to achieve effective teaching of grade 11 Chemistry and Physics?
16. What factors constrain your teaching when using the named different teaching and learning support materials for effectively teaching of grade 11 Chemistry and Physics contents in Kavango East Region?
17. Suggest how do you deal with these factors you have identified
18. In your opinion, what type of teaching and learning support materials can be used more often for effective teaching of Grade 11 Chemistry and Physics contents? And which of the materials will you recommend other teachers to use during their teaching?
19. Suggest how best that the grade 11 Chemistry and Physics teachers can be supported to improve their use of TLSMs for effective teaching of Grade 11 Chemistry and Physics contents?

THANK YOU

Appendix 13: Lesson Observation Schedule -Chemistry and Physics

School digit: .....
Teacher digit: .....
Date: ...../...../ 2021
Subject: ……
Grade: .....
Topic(sub-topic):
.....

1. Classroom environment.

1.1 The size of the classroom

	Yes	**No**
Less than 30 learners in a classroom		
30 learners and more		

1.2 Classroom arrangement

	Yes	**No**
Support learner centred		
Support teacher centred		

1.3 Classroom Physical environment

	Yes	**No**
Clean		
Enough space for teachers and learners movement		
Notice board displayed subject related charts, graphs, periodic table etc.		

2. Teachers' use of different teaching and learning support materials for effective teaching of grade 11 Chemistry and Physics.

2.1 Which teaching and learning support materials the teacher used for effective teaching of Grade 11 Chemistry and Physics?

Statement	Yes	No
Chalkboard		
Posters		
Textbooks		
Charts		
Recycled materials		
ICT (Laptops/Desktop computer/internet/Projectors/ Overhead Projectors (OHP))		
Printed media (Handouts)		
Laboratory apparatus/equipment		
Videos (You Tube)		

Others:

_____
___

2.3 The teaching methods used when using teaching and learning support materials for effecting teaching of Grade 11 Chemistry and Physics in the classroom.

	Yes	No
Teachers-centred method		
Learner-centred method		
Practical method		
Group work method		

Discussion method		

Others:

_____

___

3. Availability of teaching and learning support materials which teachers used for effective teaching of Grade 11 Chemistry and Physics.

	Yes	No
Plenty teaching and learning support materials at school		
All Grade 11 learners have their own Chemistry and Physics textbooks		
The school has a well equipped Chemistry and Physics laboratory.		

4. The teachers subject knowledge when using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	Yes	No
The teacher has adequate knowledge of Grade 11 Chemistry and Physics.		
The teacher improvises with local materials when doing practical activities in Chemistry and Physics.		
The teacher uses audible tone in simple scientific language to make learners understand Grade 11 Chemistry and Physics.		
The teacher finds it challenging when referring to real life materials in Grade 11 Chemistry and Physics sections.		
The teacher finds it challenging to carry out some experiments outlined in the syllabus as a result of inadequate skills for practicals.		
The teacher uses Grade 11 Chemistry and Physics Examiners reports to effectively teach and assess learners.		

5. The attitudes of learners when using teaching and learning support materials to teach effectively Grade 11 Chemistry and Physics.

Statements	Yes	No
Learners are eager to use the materials during Grade 11 Chemistry and Physics lessons.		
Learners misbehave when using teaching and learning materials during lesson/practical activities.		
Some learners do not pay attention when teaching Chemistry and Physics.		
Learners like seeing and using teaching and learning materials during Chemistry and Physics lesson.		

6. Challenges of teaching Grade 11 Chemistry and Physics curriculum using the available teaching and learning support materials.

Statements	Yes	No
Required period (Double periods) prescribed by the syllabus of Grade 11 Chemistry and Physics is not reflecting on the timetable.		
Inadequate number of Grade 11 Chemistry and Physics teachers at the school.		
Grade 11 Chemistry and Physics teaching other subjects in the school.		

7. The interaction of teacher and learners when teaching using teaching and learning support materials in Grade 11 Chemistry and Physics.

Statements	Yes	No
The teacher allows Grade 11 Chemistry and Physics learners to use teaching and learning support materials when doing practical's under guidance.		
The teacher uses learners to design the teaching and learning support materials used in Chemistry and Physics lessons.		
The teacher allows learners to do peer teaching using teaching and learning support		

materials in Chemistry and Physics lessons.		

8. The teacher's commitments when using teaching and learning support materials in their teaching of Grade 11 Chemistry and Physics.

Statements	Yes	No
The teacher manages lesson time for teaching Grade 11 Chemistry and Physics effectively.		
The teacher marks the tasks given to the learners and provides corrective feedback clearly on the chalkboard.		
The teacher gives test on printed materials in Grade 11 Chemistry and Physics.		

9. Teacher's provision of learning support in Grade 11 Chemistry and Physics

Statements	Yes	No
The teacher gives prescribed Grade 11 Chemistry and Physics textbooks to all learners.		
The teacher provides learners with Grade 11 Chemistry and Physics curriculum (syllabus) to follow as they progress topic-by-topic.		
The teacher uses videos through You Tube projections as teaching and learning support materials in the classroom.		
The teacher writes or print notes in clear font on the chalkboard for all learners to see.		
The teacher uses printed materials like handouts to save time where learners have to cope note, and to maximize teaching time.		

10. Teachers' pedagogical content knowledge when using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	Yes	No
The teacher uses teaching materials to help learners acquire quality knowledge construction in Chemistry and Physics.		
The teacher uses teaching and learning materials to instill skills of handling of apparatus in learners of Grade 11 Chemistry and Physics.		
The teacher uses teaching materials to arouse learners' interest and gain attention during the lesson.		
The teacher uses teaching and learning support materials when teaching to allow learners to interact with one another using the resources.		

11. Practical work using teaching and learning support materials for effective teaching of Grade 11 Chemistry and Physics.

Statements	Yes	No
The teacher uses improvised teaching and learning materials when doing practical with learners in Grade 11 Chemistry and Physics		

Thank you for your time

Appendix 14: Raw data for Figure 5- Ways in which Chemistry and Physics teachers use TLSMs for effective teaching of Grade 11 Chemistry and Physics

Statements	Participants Responses in percentages / %			
	A	SA	D	SD
Quality knowledge construction and enduring memory	71	19	4	6
To instill scientific knowledge of handling apparatus	71	14	9	6
To arouse learners attention and enhance concentration	76	19	5	0
To facilitate guided interactions between learners	57	14	29	0

Appendix 15: Raw data for Figure 6-TLSMs used in teaching Grade 11 Chemistry and Physics

TLSMs	Participants responses / %
Textbook	86
Chalkboard	82
Laboratory apparatus and chemicals	68
Notes handouts	77
Projectors	32
Computer/laptop	23
Posters	32
Videos/You-Tube	36
Self-made models	41
Manuals	41
Past exam papers	82

Appendix 16: Raw data for Figure 7-Regular use of TLSMs during teaching of Grade 11 Chemistry and Physics

Statements		In every lesson I teach	Sometimes	Only when I want to	Not at all
Participants responses / %	A	40	50	10	0
	SA	50	50	0	0
	D	40	20	30	10
	SD	12	12	31	45

Appendix 17: Raw data for Figure 8-The teachers' teaching methods when teaching using TLSMs for effective teaching of Grade 11 Chemistry and Physics in classroom

	Participants Responses / %			
Statements	A	SA	D	SD
Teachers-centred method	43	14	33	10
Learner-centred method	48	42	10	0
Practical method	62	14	14	10
Group work method	62	14	14	10
Discussion method	57	19	14	10

Appendix 18: Raw data for Figure 9-Problems experienced by teachers when using the TLSMs in teaching of Grade11 Chemistry and Physics

TLSMs	Participants responses / %
Lack of textbooks	95
Lack of laboratory apparatus and chemicals	87
Limited rim sheet (photocopy paper)	87
Time consuming (write on chalkboard and design posters)	82
Lack of practical skills amongst teachers	69
Lack of Chemistry and Physics laboratory	93
Lack of past exam papers for New Grade 11 curriculum	90
Lack of internet access	83

Appendix 19: Raw data for Figure 10-Teachers subject knowledge when using TLSMs for effective teaching of Grade 11 Chemistry and Physics

Statements		I have adequate knowledge of Grade 11 Chemistry and Physics syllabi.	I find it difficult to improvise with local materials when doing practical activities	I use audible tone in simple scientific language to make learners understand when teaching	I find it challenging when referring to real life examples in the class	I find it challenging to carry out some experiments outlined in the syllabus as results of inadequate skills for practical	I use Chemistry and Physics Examiners' reports to effectively teach and assess my learners
Participants responses / %	A	80	28	43	33	65	42
	SA	10	24	38	33	19	53
	D	10	10	19	24	10	5
	SD	0	38	0	10	6	0

Appendix 20: Raw data for Figure11-Challenges of teaching Grade 11 Chemistry and Physics curriculum using the available TLSMs

Statements		Textbook do not match with subject syllabus	Inadequate timetable slot	Teachers' high work load	Inadequate TLSMs
Participants responses / %	A	38	19	19	43
	SA	24	5	24	38
	D	24	62	43	19
	SD	14	6	14	0

Appendix 21: Raw data for Figure 12-The teachers' commitment when using TLSMs in their teaching of Grade 11 Chemistry and Physics

Statements		Effectively manage the lesson time	Mark tasks and provide timely feedback	Give test at the end of each topic	Finish syllabus on time
Participants responses / %	A	43	52	62	48
	SA	14	43	38	52
	D	38	5	0	0
	SD	5	0	0	0

Appendix 22: Raw data for Figure 15-The attitudes of learners with teachers' use of TLSMs in Grade 11 Chemistry and Physics lessons in the study area

Statements		Learners are eager to use the materials during Grade 11 Physics and Chemistry lessons.	Learners misbehave when using teaching and learning materials during practical activities.	Some Grade 11 learners believe that Physics and Chemistry is difficult.	Some learners do not pay attention when teaching Physics and Chemistry.	Learners like seeing and using teaching and learning materials during Physics and Chemistry lesson.
Participants responses / %	A	52	10	62	43	52
	SA	38	5	28	10	48
	D	5	61	10	47	0
	SD	5	24	0	0	0

Appendix 23: Raw data for Figure 16-Indicators of teacher-learner interaction when teaching using TLSMs in Grade 11 Chemistry and Physics

Statements		I Always allow Grade 11 Chemistry and Physics learners to use TLSMs when doing practical's under my guidance.	I use learners to design the TLSMs I use when teaching Chemistry and Physics.	I allow learner to do peer teaching using TLSMs in Chemistry and Physics lessons.	I encourage my Grade 11 Chemistry and Physics learners to evaluate their own work.
Participants responses / %	A	47	33	43	62
	SA	24	14	10	19
	D	24	29	33	19
	SD	5	24	14	0

Appendix 24: Raw data for Figure 17-Teachers'provision of TLSMs to Grade 11 Chemistry and Physics learners

Statements		I give prescribed Grade 11 Physics and Chemistry textbooks to all my learners where possible.	I provide my learners with Grade 11 Physics and Chemistry curriculum (syllabus) to follow as we progress topic-by-topic.	I use videos through You Tube projections to complement my teaching using TLSMs in the classroom.	I always write or print notes or activities in clear font on the chalkboard for all learners to see.	I sometime use printed materials like handouts of notes to save time for my learners copying and maximize teaching time.
Participants responses / %	A	62	25	19	48	48
	SA	33	10	0	48	48
	D	0	60	57	4	4
	SD	5	5	24	0	0