

Science Teachers' Usage of Teaching and Learning Support Materials for Effective Teaching

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Abstract: The study investigated Physics and Chemistry teachers' usage of different Teaching and Learning Support Materials (TLSMs) for effective teaching of Grade 11 Chemistry and Physics in Senior Secondary Schools in the Kavango East Region, Namibia. Following the sequential explanatory mixed methods research design, closed-ended questionnaires, interviews, and live classroom observations were used to collect data from all the twenty-one Chemistry and Physics teachers and one Science Education Officer in the region. Thus, the participants were selected using the total population sampling method. Descriptive statistics was used to analyse the quantitative data while the qualitative data was analysed thematically. Findings from the study revealed that the teachers mainly used TLSMs when teaching Grade 11 Chemistry and Physics to make scientific concepts more understandable to learners, instil scientific skills in learners, attract learners' attention, and prompt guided interactions between learners. The study also revealed that the teachers used relevant teaching approaches such as a learner-centred approach that includes group work and practical methods when using TLSMs to teach Grade 11 Chemistry and Physics. However, findings from the live classroom observations showed that the teachers need training on the best practices of using TLSMs and methods to achieve effective teaching of the Grade 11 Chemistry and Physics in the study area.

Keywords: Effective teaching, Chemistry, Physics, TLSMs, Kavango East Region

1. Introduction

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 in schools to facilitate learning and understanding of concepts among students (Alenezi, 2020). In Namibia, the Ministry of Education, Arts and Culture recognises TLSMs as important and helpful reference materials for Chemistry and Physics teachers, learners and curriculum developers. According to Milligan et al. (2019), there are many assumptions about the ways in which learning and teaching support materials can contribute to improved learning outcomes in many international contexts, especially in lieu of good pedagogical practice. In the new curriculum for the Namibian Senior Secondary Certificate Ordinary Level (NSSCO) Chemistry and Physics, it was emphasised that scientific skill and knowledge acquisitions require efficient and effective use of TLSMs and processes. However, all such TLSMs require ample knowledge and skills on their usages for effective teaching of Chemistry and Physics in the classroom to take place. Ajoke (2017), 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 a 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 recent NSSCO Chemistry and Physics Examiners reports suggest that there is very little to no meaningful utilization of TLSMs by Chemistry and Physics teachers to improve teaching and learning outcomes in this region. Akpan and Babayemi (2022), concurred that effective Chemistry and Physics teaching and learning cannot occur in the classroom environment if essential TLSMs are not available or used by the teachers. However, in poor-resourced schools, the availability and actual use of different TLSMs might be a constraint to Chemistry and Physics teachers.

Onuoha-Chediebere (2016) emphasized that TLSMs are expected to transmit and disseminate information to learners in such a way that complex concepts will be modified into simple tasks. Romlah and Latief (2021), held that science teachers' usage of instructional materials when teaching is a pre-requisite for the effective implementation of Outcome-Based Education, and this is quite critical for effective teaching of Grade 11 Chemistry and Physics, especially in the Kavango East Region. According to Pecay (2017), teachers need to be aware of what the learners 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, including the learners' perspectives in using those materials (Pecay, 2017). 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 (Romlah & Latief, 2021).

In a study on teachers and teaching with instructional materials in science subjects in Nigeria, Philip and Denwigwe (2017), stated that Chemistry and Physics teachers used teaching support materials with the objectives of providing concrete background for conceptual thinking, attracting a high degree of students' interest and concentration in class, 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 stimulating self-activity on the part of the learners. However, the Namibian national examiners' reports indicated that Chemistry and Physics teachers in the Kavango East Region did not use TLSMs during their teaching as evident in many learners' inability to correctly identify related tools during examinations; for example, many learners labelled 'beaker as jar'. This suggests that the Chemistry and Physics teachers in the Kavango East Region might not effectively use TLSMs in their teachings to expose their learners and enable them to connect theories and applications procedurally. The ineffective usage of TLSMs in the teaching process might create a gap between the knowledge taught by the teachers and the knowledge applied by the learners in related concepts. Thus, this study investigated how Chemistry and Physics teachers make use of TLSMs in order to effectively teach Grade 11 Chemistry and Physics in the Kavango East Region, Namibia.

2. Methodology

2.1 Research design

This study used the sequential explanatory mixed methods design involving quantitative phase followed by qualitative phase to collect data. This research approach provided some significant opportunities for us to gain a deeper understanding 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 total population sampling technique was used to select all the 21 Grade 11 Chemistry and Physics teachers currently teaching in Senior Secondary Schools, and one Science Education Officer (SEO) in the Kavango East Region. Thus, the study sample consisted of 22 participants.

All 22 participants were identified with pseudonyms and they completed the questionnaires after which a sub-sample of 10 Chemistry and Physics teachers, and the one SEO were purposively selected to participate in the follow-up interviews and classroom observations.

The questionnaires were designed based on a four-point Likert scale (A-Agree, SA-Strongly Agree, D-Disagree, and SD-Strongly Disagree) to survey the ways that Chemistry and Physics teachers use TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area. Furthermore, a face-to-face interview was used to gather follow-up in-depth data on the ways the teachers use TLSMs to effectively teach Grade 11 Chemistry and Physics. Each interview session was audio-recorded using a voice recorder (Sony ICD-UX570) and lasted for an average of 30 minutes. Additionally, live classroom observations were carried out in 10 different classes to personally capture the ways that the teachers use TLSMs when teaching Grade 11 Chemistry and Physics. Cohen et al. (2017), define observation as the systematic process of recording the behavioural patterns of participants, objects, and occurrences without necessarily questioning or communicating with them. The aim of triangulating the data collection using multiple instruments was to assess the ways that the teachers use TLSMs when teaching Grade 11 Chemistry and Physics from different perspectives, and to assess whether or not, the findings supplement one another.

2.2 Data analysis

Descriptive statistics (means, percentage and frequency distribution) were used to analyse the quantitative data and then presented in tables. On the other hand, thematic analysis method was used to analyse the qualitative data whereby, the data were grouped into themes that emerged based on the research problem. First, the recorded interviews were transcribed verbatim and coded. 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 (Cohen et al., 2017; Manning, 2017). Finally, the coded data were organized into themes based on the research problem, and discussed in details.

2.3 Research ethics

After obtaining the research ethical clearance certificate from the University of Namibia's research ethics committee, we sought and obtained written permissions 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, we sought and obtained written permission from the Principals of the schools where the participants are located before meeting the participants. The participants were informed about the purpose of the research and their anonymity were assured by using pseudo-names. The participants were also informed that their participation in the study was voluntary and they were assured of their right to freely withdraw from the study if they feel uncomfortable to continue with the study 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. Results and discussion

3.1 Demographic information

The demographic characteristics of the study participants are presented in Table 1 below. The table 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 consist of younger teachers in the youth age bracket. This indicates that the region has active and energetic teachers in the field of Chemistry and Physics. The table shows that all the Chemistry and Physics teachers who participated in the study had different teaching qualifications but the majority (54.4%) of them had the Bachelor of Education (Honours). This shows that the Chemistry and Physics teachers who participated in the study were well qualified to teach these subjects in the study area. This corroborate the findings by Norro (2022) 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. Majority of the teachers (95.5%) had 1-5 years of teaching experience. These findings indicated that majority of the participants had fewer years of teaching experience and this might negatively affect the effective usage of TLSMs by the Chemistry and Physics teachers in their classroom teachings.

Table 1: 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
Age in years	20-29	5	22.7
	30-39	15	68.2
	40-49	1	4.5
	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 Hons)	13	54.4
	Bachelors of Science Honours (B.Sc Hons)	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
	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
Years in which highest qualification obtained	11-15	1	100
	Before 1989	0	0
	1990-2000	0	0
	2001-2010	3	13.6
	2011 +	18	85.7
SEO	2011+	1	100

Ceka and Murati (2016) highlighted that the experience of teachers is crucial in developing and using relevant TLSMs for teaching effectiveness, emphasizing that more skills are acquired as the teacher gains more years of experience. In a study titled “Too little or too much: Teacher preparation and the first years of teaching”, Liston et al. (2006) noted that some newly qualified teachers opined that the theoretical grounding that they learned in teacher preparation does not equip them sufficiently for the demands of daily classroom life. Hence, Hill’s (2014) suggested that schools need teachers

with many years of teaching experience in the field to effectively teach the subject contents, and hence, effectively use TLSMs in their classroom teachings. Potočnik and Devetak (2023) asserted that lack of knowledge and experience about the use of different materials in teaching leads to unsuccessful usage of materials by the teachers.

Advantageously, the SEO in the Kavango East Region had a vast experience (11 to 15 years) of advisory service in the science stream which include Grade 11 Chemistry and Physics. Therefore, he might provide helpful advice to the less experienced Chemistry and Physics teachers in the Kavango East Region in terms of identifying and developing relevant TLSMs and using them for effective teaching of Chemistry and Physics.

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

Figure 1 shows the teachers' responses on the ways in which they use TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area. The findings revealed that majority of the participants agreed (71%) and strongly agreed (19%) that they use TLSMs to help their learners acquire quality knowledge and enhance memory in Chemistry and Physics concepts. Furthermore, majority of the participants agreed (71%) and strongly agreed (14%) that they use TLSMs to instill skills of handling apparatus in their learners. Majority of the participants (76%) also indicated that they use TLSMs to attract learners' attention and enhance concentration during lessons. The results further revealed that majority of the participants agreed (57%) and strongly agreed (14%) that they use TLSMs to facilitate guided interactions among the learners. Findings from the follow-up interview and live classroom complemented the results obtained from the questionnaires as the teachers were seen using different available TLSMs to instill scientific skills of handling apparatus in their learners, helping the learners to acquire quality knowledge and long-term memory of learned concepts, attracting learners' attention and enhancing concentration during lessons, and providing guided interaction among the learners using TLSMs. This corroborates the study report by Tuimur

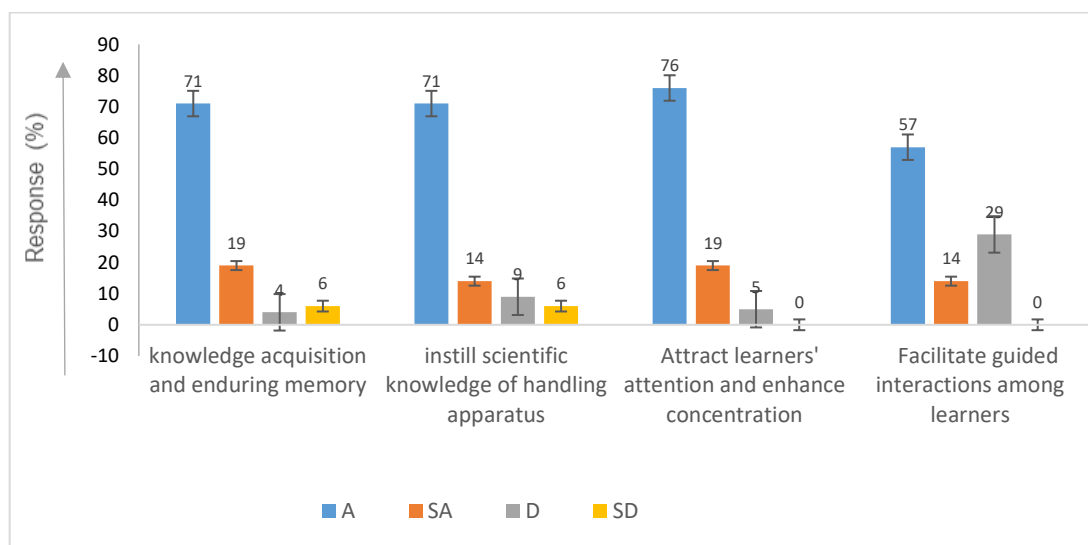


Figure 1: Ways in which Chemistry and Physics teachers use TLSMs for effective teaching of Grade 11 Chemistry and Physics in the study area

and Chemwei (2015) where the authors noted that the use of TLSMs in classroom teaching has the potential to help teachers explain new concepts clearly, resulting in better learners' attention and understanding of the concepts being taught.

The findings revealed that the teachers used TLSMs in positive ways as actions such as instilling scientific skills for handling apparatus, interaction among learners, attracting learners' attention, and enhancing long-term memory of learned concepts are critical for effective teaching and learning, especially in science subjects such as the Grade 11 Chemistry and Physics. The study found that both the teachers and SEO believed that the different ways in which the teachers use TLSMs as primary driving resources leads to effective teaching of Grade 11 Chemistry and Physics in the classroom. For effective teaching to prevail, teachers are encouraged to use TLSMs or objects to offer latitude for shaping lessons to students' interests and needs in the classroom (Sieber & Hatcher, 2012). In a study conducted in Australia, Loughran et al. (2004) noted that the use of TLSMs in science teaching is a combination of teacher's knowledge of instructional materials and subject content, in ways that best engender students' 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 (Maselwa & Ngcoza, 2003). Moreover, Milligan et al. (2019), noted that the use of TLSMs facilitates active participation of both teachers and learners in the teaching and learning process through discussion and other pedagogical support structures. Interestingly, Philip and Denwigwe (2017),

outlined that in the classroom, “instructional materials usage can supply a concrete basis for conceptual thinking; have a high degree of interest for students; supply the necessary basis for developmental learning and make learning more permanent; offer a reality of experience which stimulates self-activity on the part of the learners; provide experience not easily secured by other materials and contribute to efficiency, depth and variety of teaching and learning processes”. Advantageously, TLSMs aids the demonstration and formulation of concepts, instructive techniques, knowledge of what makes concepts difficult to learn, knowledge of what learners know, and theories of subject contents in science teaching (Koehler, 2011).

3.3 Types of TLSMs used by the teachers for effective teaching

The participants were asked to state the types of TLSMs they used in their classrooms to ensure effective teaching of Grade 11 Chemistry and Physics contents. The findings in Figure 2 revealed that 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. 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 notes/handouts were the most commonly used TLSMs by Chemistry and Physics teachers teaching in Senior Secondary Schools in the Kavango East Region. Additionally, during the follow-up interview, some participants listed other TLSMs which they used to achieve effective teaching of Grade 11 Chemistry and Physics. 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”*, Additionally, Teacher H₁ stated that *“we use question papers as TLSMs when preparing Grade 11 Chemistry and Physics learners for their end of year examination”*.

The findings revealed that the Chemistry and Physics teachers use different types of TLSMs to make their teaching more effective and understandable to the learners. The Namibian National Curriculum for Basic Education 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. In a different study, Kusi (2017) noted that using chalkboard as a teaching and learning support material improves teaching

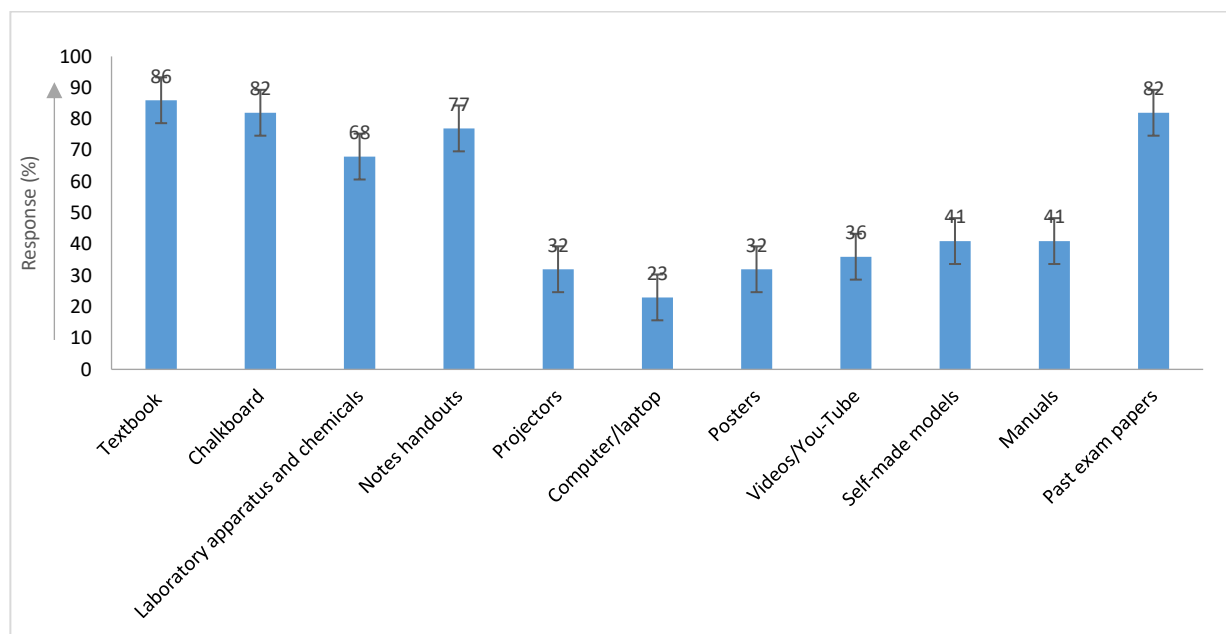


Figure 2

Types of TLSMs used by teachers for effective teaching of Grade 11 Chemistry and Physics at schools 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. Alenezi (2020) in his study noted that using chalkboard as a teaching support material is a must for teaching in schools and colleges as chalkboard make it easier for teachers to control the pace of a lecture because it encourages writing while talking. In addition, Alooovi (2016) highlighted that TLSMs such as pictures, specimens of flowers and the likes, attract learners’ interest and make them pay attention to what is being taught and make it more understandable.

3.4 Frequency of using TLSMs during teaching of Grade 11 Chemistry and Physics

The findings in Figure 3 revealed that majority of the participants (50%) strongly agreed 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, some participants disagreed (10%) with the statement that they use TLSMs in every lesson. Thus, the result indicated that most of the Chemistry and Physics teachers in secondary schools in the Kavango East Region made use of TLSMs in their teachings even though, this is not regular among some participants.

Furthermore, the results in Table 2 indicated that the SEO strongly disagreed with the statement that the teachers are not using TLSMs when teaching Grade 11 Chemistry and Physics but strongly agreed that the teachers use TLSMs sometimes when teaching the subjects. The SEO also strongly agreed with the statement that the teachers use TLSMs only when they want to use these materials during teaching. These findings complement the results obtained from the teachers' questionnaire and show that they (Chemistry and Physics teachers) sometimes use TLSMs during their teachings. While Kusi (2017) agreed that teachers most often did not use teaching-learning resources in their lesson delivery. However, they observed that students enjoyed and understood

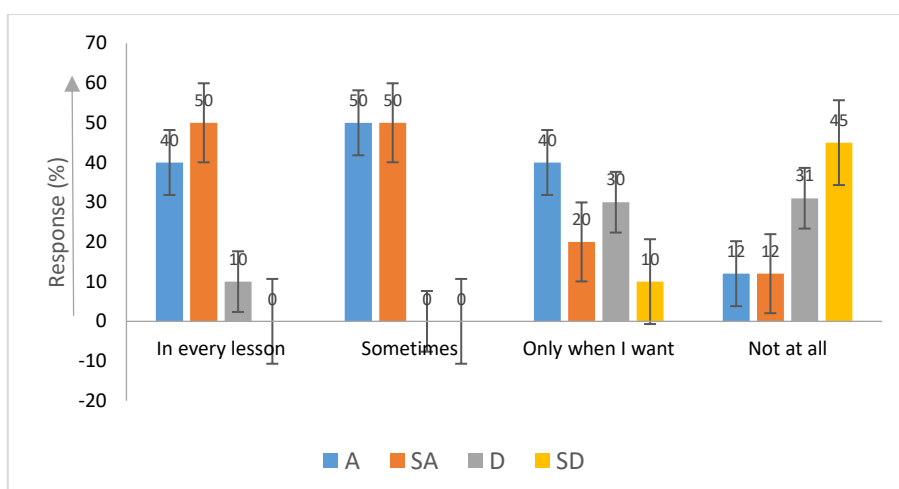


Figure 3

Teachers' frequency of using TLSMs when teaching Grade 11 Chemistry and Physics

Table 2 SEO's response on the teachers' frequency of using TLSMs when teaching Grade 11 Chemistry and Physics

Statements	Response			
	A	SA	D	SD
In every lesson I teach	-	-	√	-
Sometimes	-	√	-	-
Only when I want to	-	√	-	-
Not at all	-	-	√	-

better in the few lessons which teachers used teaching-learning resources. Advantageously, teaching-learning resources provide complete example for conceptual thinking and creates the environment of interest for the learners (Alenezi, 2020). Thus, it is crucial for Chemistry and Physics teachers in the Kavango East Region to use TLMs more often for effective teaching of the subject in Grade 11.

3.5 The teachers' teaching methods when using TLSMs in Grade 11 Chemistry and Physics classrooms

The participants' responses on the teaching methods used by the teachers when using TLSMs to teach Grade 11 Chemistry and Physics are as presented in Figure 4. Majority of the participants agreed that they used different teaching methods, namely, teachers-centred, learner-centred, practical teaching, group work and discussion methods. Furthermore, findings from the follow-up interviews and live classroom observations indicated that most teachers used different teaching methods when using TLSMs in their teachings. The use of different teaching methods especially when teaching Chemistry and Physics is necessary to achieve effective teaching of the contents. However, two participants added the following:

"the learner-centred method is challenging due to poor participation by the learners" (Teacher F₁).

"learners should be taken on an excursion tour to discover scientific processes such as chlorination of water at Namwater plant" (Teacher O₁).

As seen in Table 3, the SEO agreed that 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 may require the use of every kind of teaching methods. For example, Lachance (2014) reported that the use of group work teaching method when using TLSMs makes learners to

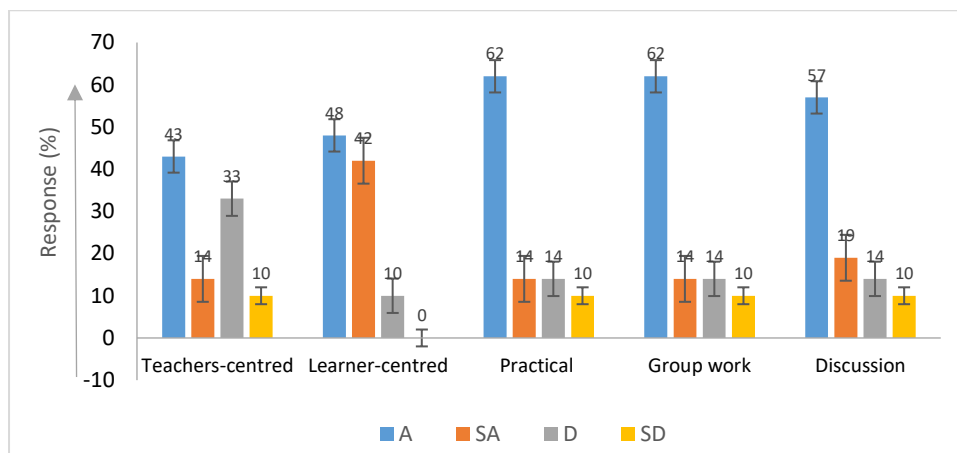


Figure 4

The teachers’ teaching methods when using TLSMs in Grade 11 Chemistry and Physics lessons

Table 3 Expected teaching methods when teachers use TLSMs to teach Grade 11 Chemistry and Physics

Statements	SEO’s response			
	A	SA	D	SD
Teacher-centred method	√	-	-	-
Learner-centred method	-	√	-	-
Practical method	-	√	-	-
Group work method	-	√	-	-
Discussion method	√	-	-	-

give-and-take their understanding of the subject through interaction with other learners. In another report, Niyitanga et al. (2021) 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 lead to ineffective use of TLSMs. Moreover, Kapenda (2008) asserted 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 use under insufficient teaching and learning resources. The learner-centered teaching method entails that learners primarily do most of the work (be it practical with hands-on materials, writing or group discussions) in the classroom than just the teacher talking. However, as stated by Isa et al., (2020), the teacher’s choice of a particular teaching method depends on the content to be taught, the lesson objectives as well as the availability of teaching and learning resources. Whether a single or combination of teaching methods will be used to deliver lesson content, Niyitanga et al. (2021) emphasized that the classroom learning environment should support real interaction of multiple activities with pupils’ scholastic achievement. Thus, when teachers decide about teaching method, they should be flexible and keen to adjust their teaching styles to students’ needs, success and achievement to make teaching method more effective (Kusi, 2017). This is very important for effective teaching and learning using TLSMs in the Kavango East Region – the study area. The best teaching strategy always activates learners’ prior knowledge which enable them to make connections between the previous knowledge and the new concept being taught or learned (Saido et al., 2017).

4. Conclusion

The main aim of this study was to investigate the ways that Chemistry and Physics teachers made use of Teaching and Learning Support Materials (TLSMs) for effective teaching of Grade 11 Chemistry and Physics in Senior Secondary Schools in the Kavango East Region of Namibia. The results of the study revealed that the teachers mainly used TLSMs when teaching Grade 11 Chemistry and Physics to makes scientific concepts more understandable to learners, instil scientific skills in learners, attract learners’ attention, as well as prompt guided interactions between leaners. These could lead to effective teaching of the Chemistry and Physics contents. Furthermore, the study revealed that the teachers used relevant teaching methods such as learner-centred approach, group work and practical method when using TLSMs to teach Grade 11 Chemistry and Physics. However, it is not known whether the teachers’ teaching method when using TLSMs follow best practices that will produce the desired teaching and learning outcome in the study area. Therefore, it

is important to carry out further studies to establish the teachers' actual teaching methods and practices of these methods when using TLSMs for effective teaching of Grade 11 Chemistry and Physics. This is necessary for planning interventions and training programs to equip the teachers with the best method and practice of using TLSMs for effective teaching of Grade 11 Chemistry and Physics.

5. Limitation and Implication for future research

This study was only conducted in Senior Secondary Schools in the Kavango East Region of Namibia. Thus, the results of the study may not reflect the complete picture of Science teachers' use of Teaching and Learning Support Materials (TLSMs) for effective teaching of Grade 11 Chemistry and Physics in all the 13 regions of Namibia. Therefore, the study can still be conducted in the other regions of Namibia in order to develop a country-wide response to improve the uses of different TLSMs for effective teaching of science subjects in secondary schools.

Conflict of interest

The authors declare that there is no conflict of interest regarding the conduct and publication of this work.

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