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Research Article

Evaluating the Teaching of Physical Science Practical Work at a Selected Resource-Constrained Secondary School in Rundu Circuit, Kavango East Region

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Abstract
This study evaluated the teaching of Physical Science practical work at a resource-constrained secondary school in the Rundu Circuit, Kavango East region in Namibia. The research objectives were to assess the impact of practical work on learners' academic performance in a resource-constrained community, identify the challenges faced by both teachers and learners in conducting practical activities, and propose strategies to address these challenges and improve the overall quality of science education. A qualitative research design was employed, with data collected through semi-structured interviews involving four Physical Science teachers. The interviews were analyzed using thematic analysis, with themes aligned to the research objectives. The findings revealed that the state of science practical work was poor due to a lack of sufficient laboratory equipment and resources. Other significant challenges identified included limited laboratory space, inadequate time allocation, overcrowded classrooms, a lack of motivation among learners, and insufficient background knowledge on practical work for learners. These challenges collectively impeded effective teaching and learning of science practical work. To overcome these issues, the study recommended providing adequate laboratory materials and constructing an additional laboratory to alleviate overcrowding. The study also further recommended the employment of laboratory technicians to assist teachers in organizing, planning and conducting practical activities more efficiently. Furthermore, the study suggested forming partnerships between schools to share laboratory facilities, as per Key Area 7 of the National Standard and Performance Indicators for Schools in Namibia, which emphasizes the importance of collaborative linkages within educational communities. By implementing these strategies, it was concluded that the quality of Physical Science practical work in resource-constrained schools could be significantly enhanced, leading to improved learner outcomes.

Keywords: National Standard, Physical Science, Practical Work, Resources-Constrained Schools, Secondary Education

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1. INTRODUCTION

Namibia, situated in the southwestern region of Africa, has demonstrated a steadfast dedication to improving its education system in order to align with the requirements of an interconnected and technologically advanced globe (Kambeyo, 2018). The Namibian Ministry of Education, Arts and Culture (MoEAC) has shown a keen interest in adopting inquiry-based instruction to foster the development of learners' scientific literacy and critical thinking abilities (Katukula, 2018). Nevertheless, the effective implementation of inquiry-based instruction is mostly dependent on teachers, as they play a pivotal role in facilitating this pedagogy in the classroom. Therefore, it is imperative to examine the perceptions of Namibian science teachers about inquiry-based education, the factors that impact their adoption of this approach, and the extent to which their opinions coincide with the objectives set by the MoEAC.

The importance of science education in determining a nation's future lies in its ability to cultivate critical thinking, problem-solving abilities, and a scientific attitude among its populace (Mwazi, 2022). In recent years, there has been an increasing acknowledgement of the necessity for a fundamental change in science education, shifting away from conventional and/or traditional teacher-centred systems towards a more learner-centred and inquiry-driven method (Logeswaran et al., 2021; Nair, 2020). This transition corresponds to the changing expectations of the 21st century, prioritising the development of abilities that extend beyond mere memorisation (Tan, 2021).

Namibia, like numerous other nations, is experiencing significant changes in its educational sector to address the demands of a quickly progressing global environment (Jellenz et al., 2020; Paranad et al., 2023). The field of science education is currently leading the way in implementing these reforms, with an emphasis on actively involving learners in ways that improve their conceptualisation of scientific principles (Jimenez-Liso et al., 2021; Rodriguez & Morrison, 2019). An increasingly prominent technique is the use of inquiry-based instruction, which involves learners actively engaging in the learning process by exploring, experimenting, and making discoveries (Cairns & Areepattamannil, 2019; Chu et al., 2021; Gholam, 2019; Husni, 2020; Yıldız-Feyzioğlu & Demirci, 2021).

Science education in Namibia has undergone a significant change in recent years, shifting from a traditional teacher-centred approach to a more learner-centred and engaging pedagogies (Mwazi, 2022; Potokri & Mwelitondola, 2022; Shatumbu, 2019). This change is particularly evident in science education, as highlighted by a studies conducted by Sheehama (2018). An example of a modern teaching method that is becoming increasingly popular in science education is inquiry-based instruction. Academic scholars have struggled to define and understand inquiry, leading to confusion and varied descriptions of the concept, this has resulted to its description as 'elastic' (Capps, 2012). Thus, inquiry-based instruction has become widely adopted in science classrooms worldwide as the leading contemporary teaching method (Cairns & Areepattamannil, 2019; Chu et al., 2021; Oliver et al., 2021). It enhances long-lasting acquisition of knowledge and skills among learners, making it a recognized pedagogy for the 21st century.

Inquiry-based instruction is a pedagogical approach that focuses on fostering curiosity, analytical thinking, and active participation among learners, placing them at the core of the learning experience (Abdurrahman et al., 2019; Archer-Kuhn & MacKinnon, 2020; Chu et al., 2021; Shikongo, 2022). This strategy promotes learner engagement by fostering inquiry, facilitating topic exploration, and facilitating the construction of knowledge through experiential activities and investigation (Archer-Kuhn, & MacKinnon, 2020). Understanding teachers' perceptions and implementation of inquiry-based instruction is crucial as education systems globally strive to adapt to the evolving demands of the 21st century teaching approaches. Multiple studies have repeatedly demonstrated that inquiry-based learning has a positive impact on learners' comprehension of scientific concepts and also fosters the growth of critical thinking, problem-solving, and communication abilities (Shinana et al., 2021). As a result, Teachers strive to foster a more profound and long-lasting comprehension of scientific concepts by actively engaging learners in the process of scientific inquiry.

The adoption of inquiry-based learning is founded on educational ideas like constructivism, which suggests that learners construct their understanding via active engagement and reflection (Siseho, 2018; Xu & Shi, 2018). In the domain of science education, this entails offering learners the chance to investigate real-life issues, develop hypotheses, carry out experiments, and derive findings - reflecting the methodologies employed by experts in the field (Ntinda et al., 2021).

Although the advantages of inquiry-based instruction are well recognised, the effective accomplishment of these methods relies heavily on teachers' opinions and experiences. Teachers play a vital role in the classroom by acting as primary facilitators of knowledge, helping learners through the process of inquiry. Gaining insight into the perceptions and experiences of Namibian science teachers on the transition in teaching methodologies is essential for assessing the efficacy and durability of the paradigm change in science education.

The study was guided by the following main research question: "*What are the teachers' conceptions of teaching science practical work through inquiry-based instruction in Namibian schools?*"

Based on the main research question, the following sub-research questions were set:

a) What are the science teachers' views of inquiry-based instructions?

b) How do science teachers' views of inquiry-based instructions facilitate science practical work?
c) What factors are affecting science teachers' usage and enactment of inquiry- based instructions in their science practical work?

1.1. Literature Review

1.1.1. The Concept of Practical Work in Science

The concept of practical work in science encompasses teaching and learning activities that engage learners' science process abilities to observe and interact with real objects and materials, facilitating a deeper understanding of the natural world beyond their immediate surroundings (Baraquia, 2022; Shivolo & Mokiwa, 2024). This approach bridges the gap between the domain of scientific ideas and the field of observable phenomena, making new scientific concepts, theories, and models more comprehensible for learners (Dayal & Ali-Chand, 2022). The primary goals of science education, as noted by Mutilifa and Kapenda (2017), are to ensure learners grasp scientific concepts suitable to their needs and interests while enhancing their understanding of scientific methods and skills. This is achieved by emphasizing the practical activities that relate directly to the theoretical concepts taught in class, thereby fostering critical thinking and science process abilities (Babalola et al., 2020).

Moreover, practical work in science education should involve both action and reflection, encouraging learners to interact with real items and materials, which helps them connect theoretical and practical knowledge (Baraquia, 2022). This hands-on approach not only promotes collaborative learning and the development of 21st century skills but also motivates learners to engage more actively in the learning process, fostering a sense of ownership over their educational experiences (Bean & Melzer, 2021; Booc et al., 2023). Collaborative efforts in practical work allow learners to construct their understanding and develop problem-solving, data interpretation, and theory discussion skills, which are crucial for scientific inquiry (Panela & Deniega, 2021; De Borja & Marasigan, 2020). Despite the evident benefits, there is ongoing debate regarding the best practices for conducting practical work in science classes, particularly highlighting the need for a balanced and well-structured approach (Angeles et al., 2023).

1.1.2. The Aims and Purposes of Practical Work

Practical work is a crucial element of science education, serving multiple purposes aimed at enhancing learner engagement in scientific phenomena and improving their investigative skills. According to Dayal and Ali-Chand (2022), the objectives of practical work include stimulating and maintaining learners' interest, curiosity, and open-mindedness in science, as well as fostering creative thinking and problem-solving abilities. It promotes the understanding and application of the scientific method, such as formulating hypotheses and making assumptions, and it develops both conceptual understanding and practical skills necessary for scientific investigation. Babalola et al. (2020) further emphasize that practical work helps learners appreciate the human enterprise of science, enhances intellectual and aesthetic understanding, and cultivates transferable inquiry skills. It also encourages learners to appreciate the orderly nature of scientific knowledge and/or nature of science (NOS) and understand the tentative nature of scientific theories and models.

Furthermore, practical work in science education aims to provide learners with hands-on experience that develops their appreciation of scientific knowledge and hones their problem-solving skills (Sshana & Abulibdeh, 2020). This experiential learning approach is designed to mimic the methodologies used by scientists, giving learners the autonomy to conduct their own experiments and investigations. This active participation in scientific processes supports the construction of their own scientific knowledge, making them constructors of new knowledge rather than being passive recipients of information (Bradley, 2021; Sshana & Abulibdeh, 2020; Twahirwa & Twizeyimana, 2020). Consequently, the integration of practical work in science education is justified by its role in developing comprehensive scientific understanding and inquiry skills (Cigdemoglu & Köseoğlu, 2019).

1.1.3. Effects of Science Practical work on Learners' Academic Achievement

Science practical work significantly enhances learners' academic achievement by providing collaborating and engaging learning experiences. According to Lee and Sulaiman (2018), practical work involves learners interacting with actual or concrete objects, improving their experiences and conception of science concepts (Babalola et al., 2020). Ndoro (2017) asserts that practical activities enhance conceptual knowledge and problem-solving abilities, creating an environment conducive to learning. Bean and Melzer (2021) also highlighted that starting practical work early in secondary school helps to develop critical and analytical thinking skills by actively involving learners in the educational process rather than passive listening to the teacher presenting theoretical knowledge.

Furthermore, laboratory equipment is essential for practical work, encouraging in long-term memory development, moral aspects of science, collaboration, and active participation of learners (Alkan, 2016). These activities provide intellectual experiences that foster scientific perspectives and inquiry, making learning enjoyable and easier to retain (Shivolo & Mokiwa, 2024; Bernholt et al., 2019). Josiah (2022) notes that using equipment in science subjects, teaching increases the likelihood of knowledge retention capacity and academic performance of learners. Effective use of educational materials also improves teachers' competence and gives learners a deeper sense of purpose in their studies, reinforcing the overall benefits of science practical work (Alkan, 2016).

1.1.4. Challenges Faced by Teachers and Learners in Conducting Physical Science Practical Work

Inadequate Laboratory Facilities

Physical Science teachers in Namibian schools consider the laboratory use as the standard and the traditional approach of teaching experimental activities in science, but inadequate facilities inhibit effective practical work implementation in their classrooms (Shivolo, 2018). According to Dayal and Ali-Chand (2022), science teachers frequently lament the lack of necessary supplies, apparatus and equipment making it difficult to focus lessons on laboratory activities. Josiah (2022) supports this by highlighting the lack of funding for essential laboratory equipment, such as worktables, sinks, water supplies, and electrical outlets. Sharpe and Abrahams (2020) note the absence of recognized criteria for safe use and maintenance of laboratory items, which further discourages the utilization of labs by science teachers. Babalola et al. (2020) emphasize that sufficient tools are critical for fostering long-term memory, teamwork, and scientific attitudes in learners.

Learners with Different Learning Abilities

Teaching Physical Science to learners with varying learning styles poses significant challenges, particularly in Namibian schools which lack facilities to facilitate the teaching and learning process of science subjects. Alkan (2016) postulated that slow learners may struggle to comprehend material and complete tasks at the same pace as faster learners. Kasiyo et al. (2017) added that learners with impairments, such as albinism and hearing issues, require additional support, which can slow down the teaching process, especially if teachers are not well informed and cognizant of such learners learning difficulties. Franklin and Harrington (2019) pointed out that communication with hearing-impaired learners often involves intermediaries, leading to potential information loss and delays.

Time Constraints

A well contended issues in implementing practical work in Namibian schools, particularly in resource-constrained environments if the time allocated for investigative and experimental work from the science curriculum documents (Shivolo, 2018, 2024). Time constraints are a major barrier to conducting practical work in Physical Science, particularly at the junior primary phase where these learners who have just transited from the primary phase would require more time to engage with materials during a practical experiment. Sharpe and Abrahams (2020) argue that lack of practical skills, heavy teachers' administrative tasks, and complex material contribute to these time limitations. Bada et al. (2018) noted that most Physical Science teachers lack laboratory assistants, forcing them to handle experiment setup, supervision, and cleanup, which reduces the time available for actual teaching.

Overcrowded Physical Science Classrooms

Another notable complex issue inhibiting teachers' implementation of science practical work in Namibia is overcrowded classrooms. The current normal teacher-learner ratio at the junior secondary phase in Namibian schools is 1: 35 (Ministry of Basic Education and Culture, 2001). However, many schools in Namibia are faced with a very high teacher-learner ratio, which is way beyond the said ratio at the said phase. Overcrowded classrooms with limited resources make practical work challenging to teach. Kapici et al. (2020) stated that managing learner behaviour in large classes consumes valuable teaching time. Josiah (2022) reported that limited laboratory space, learners' lack of prior practical work experience, and indiscipline hinder effective teaching practices. Bernholt et al. (2019) indicated that teachers often conduct experiments themselves while learners observe due to the impracticality of supervising large groups.

Attitude of Teachers Toward Practical Work

Mitigating Challenges experienced during science practical work (2021) outlined that many teachers are meticulous and have naïve ideas about conducting experiments due to time constraints and the lack of necessary tools. Mutilifa and Kapenda (2017) highlighted that even trained teachers struggle to implement experimental teaching techniques effectively. Positive teacher attitudes towards science and practical work are thus correlated with better learner outcomes and higher engagement (Baraquia, 2022).

2. METHODOLOGY

2.1. Research Design

A research design is described as a plan or a strategy of how a researcher intends to conduct the research to address the research questions (Sileyew, 2019). It is essentially a plan aimed at enabling answers to be obtained from the research questions (Creswell, 2020). To produce a thorough understanding of the teaching of Physical Science practical work, this study uses a qualitative approach through a single-case study research design. A case study, according to Creswell (2016) is a research strategy that investigates a real-world, modern bounded system and several bounded systems across time by meticulous data collection from numerous sources and the reporting of a case description including case themes.

2.2. Population and Sampling

A population is defined as an adequate number of individuals from which a sample is drawn and from which the researcher derives the findings (Dougherty & Slevc, 2019). The population of this study was Physical Science teachers from a chosen secondary school in Kavango East Region, Rundu Circuit, Namibia. According to Creswell (2017) a population in research refers to the entire group of individuals or instances about whom the researcher aims to draw conclusions. It encompasses all the elements that share at least one characteristic relevant to the research question. Similarly, Frey (2018), described a sample as a group of people, objects, or items that are taken from a large population for a measurement. The study utilized non-probability sampling methods, specifically purposive. Purposive sampling enabled the researchers to use their judgment in selecting the cases (Berndt, 2020), therefore four grade 8-9 Physical Science teachers were purposively selected to participate in this study. These teachers were selected based on their subject expertise and willingness to participate in the study, due to the smallness of teachers who teach Physical Science at the school.

2.3. Research Instruments and Data Collection

Research instruments are scientific and systematic tools designed to help the researcher collect data on his/her topic of interest (Bhat, 2020). The instruments used during data collection in this study were semi-structured interviews. Bhat (2020) emphasized that in a semi-structured interview, the researcher introduces the main questions and then lets the participants answer the way they want. Therefore, the study employed a semi-structured interview, whereby the researchers introduced a set of questions to the Physical Science teachers, following them up with probe questions to explore further their responses. Moreover, the rationale for using semi-structured interviews is that it encourages two-way communication, which allows the respondents to freely express their views on the lack of resources.

Data collection is a process of gathering and measuring information on targeted variables in an established system, which then enables one to answer relevant questions and evaluate outcomes (Creswell, 2020). An appointment was made with grade 8-9 Physical Science teachers to conduct an interview. A semi structured interview was used with each participant to allow a broader discussion to be audio-recorded with consent from the participants.

2.4. Data Analysis

Kothari (2017) defines data analysis as the computation of measures along with searching for patterns of relationships that exist among the data groups. The data collected from semi-structured interviews were analyzed using the thematic analysis approach, which is a process that involves recognizing patterns within the qualitative data (Maquire & Delanunt, 2019). Furthermore, the six procedures were used in thematic analysis to locate, examine, and present the material. These six procedures included: gaining familiarity with the data through verbatim transcription of the interview and subsequent reading of the transcripts to comprehend each transcription's content; producing first codes; extracting codes, themes, and subthemes to look for themes; examining the topics in greater detail to determine whether to divide or combine them; names and definitions of themes and created the research report.

2.5. Reliability and Validity of Research Instruments

According to Varpio et al. (2021), the validity of research is the quality of the data-gathering instrument or procedure that enables it to measure what it is supposed to measure. They further added that the importance of validity is that data validation provides accuracy, cleanness, and completeness to the data set by eliminating data errors from any project to ensure that the data is not corrupted. While data validation can be performed on any data, including data within a single application such as Excel creates better results. Inaccurate and incomplete data may lead the end-users to lose trust in data (Varpio et al, 2021).

Reliability, according to Flick (2022) describes the consistency with which a method measures something. He further added that measurement is regarded as reliable if a similar outcome can be continuously obtained by applying the same techniques under the same conditions. Reliability is crucial because it gauges the caliber of the research, claims Mary and Suganya (2022). To increase reliability, the following standards were integrated into the questions: to minimize misunderstandings, semi-structured questions were constructed as straightforward as possible; a huge amount of time was allotted for participants to respond to questions.

2.6. Ethical Considerations

According to Frey (2018), ethics are the moral principles that govern a person's behavior. Research ethics may be referred to as doing what is morally and legally right in research (Resnik, 2020). In line with the University of International Management requirements for conducting research, the researcher obtained a permission letter from IUM and wrote a letter to the Directorate of Kavango East to request permission to conduct research at one selected combined school in Rundu circuit.

According to Maree (2021), informed consent is the process of telling potential research participants about the key elements of a research study and what their participation will involve. Therefore, the researchers first notified the participants that their participation was entirely voluntary and that they free were free to leave the study at any time. The researchers ensured that the participants were informed about the purpose of this study. Participants signed the informed consent form to declare their voluntary desire to participate in the data collection process. The researchers additionally ensured the participants' anonymity and confidentiality by using aliases. Before agreeing or declining to participate, participants understood the study's objective, advantages, risks, and financing.

According to Kabir (2016) anonymity means that there is no way for anyone (including the researcher) to personally identify participants in the study. Providing anonymity of information collected from research participants means that either the project does not collect identifying information of individual persons (e.g., name, address, email address, etc.), or the project cannot link individual responses with participants' identities (Kabir, 2016). In this study, the names of the respondents as well as the school's name were not mentioned in the study which means the researchers regarded the participants' privacy and confidentiality by using pseudonyms, Teachers were given codes such as Teacher A, Teacher B, Teacher C, and Teacher D, respectively. According to Mary and Suganya (2022), voluntary participation means the participants answer questions and have made a free choice to be involved in the gathering of information. He further added that participants should not be coerced into being involved in any way. It is crucial they can stop the questions, or change their mind about being involved, at any time. The decision to stop or withdraw must never impact their ability to access your peer programs. Therefore, participation in this research study was voluntary, all participants were treated with respect and withdrawal was possible at any time they felt like they could not continue giving information regarding the study.

In a research context, confidentiality means that the participants can be identified, but their identities are not revealed to anyone outside of the study (Mary & Suganya, 2022). In other words, only the researcher knew the identities of the participants, and measures were put in place to ensure that participants' identities were not revealed to anyone else. Confidentiality is best ensured through proper data management and security.

In terms of data management, participants personally are identifying information that was linked to their data using code numbers (quantitative research) or pseudonyms (qualitative research). This allowed personal identifying information to be stored separately from the data (Blumbery et al., 2021). To ensure confidentiality in this study, the names of the selected teachers did not appear in the research report.

3. RESULTS AND DISCUSSION

This study evaluated the status of Physical Science practical work at a resource-constrained secondary school in the Rundu Circuit, Namibia. The key findings revealed that the status of practical work is significantly hindered by inadequate resources and apparatus, including laboratory equipment. These findings highlight the critical need for improved resources and support for effective science education.

Additionally, challenges such as limited working space, insufficient time allocation, overcrowded classrooms, lack of motivation among both teachers and learners, and inadequate background knowledge on practical activities were identified. These findings directly address the research questions posed in the introduction, which were: *what is the status of science practical work in a resource-constrained secondary school in Rundu Circuit; what challenges do teachers and learners face when conducting Physical Science practical work in a resource-constrained environment, and what strategies can be employed to overcome these challenges during Physical Science practical work?,* highlighting the critical need for improved resources and support for effective science education.

The study employed a qualitative approach through semi-structured interviews with four Physical Science teachers at a resource-constrained secondary school. The findings of this study advance the current understanding of the challenges faced in implementing practical work in resource-constrained environments. By identifying specific barriers such as inadequate laboratory facilities and limited equipment, this research provides a detailed account of the practical difficulties encountered by teachers and learners. Furthermore, the study highlights the broader implications of these challenges, emphasizing the need for targeted interventions and resource allocation to enhance the quality of science education in similar contexts.

The interview analysis thus revealed six themes corresponding to these research questions. These emerging themes are presented and discussed below:

Theme 1: The understanding of the term practical work

Theme 2: The status of practical work at school

Theme 3: The preferable teaching methods in Physical Science

Theme 4: The frequency of carrying out practical work in Physical Science

Theme 5: Challenges faced when conducting practical work in Physical Science

Theme 6: Strategies to reduce the challenges faced during practical work in Physical Science

Theme 1: The Understanding of the Term Practical Work

Teachers have voiced their understanding of the term practical work and below are their responses: According to Teacher A:

"Practical work requires learners to do things with objects and materials".

In addition,

Teacher B has also retorted that "Practical work is when learners carry out science experiments in the laboratory with the help of the teacher".

Furthermore, Teacher C stated that:

"Practical work is when learners do experiments in the laboratory".

Whereas Teacher D responded to the question by saying:

"Practical work is the experimental, hands-on activities carried out as part of learning Science".

The findings from this study with regards to teachers' understanding of science practical work revealed that teachers commonly understand practical work as activities involving hands-on experimentation and interaction with materials. Teacher A emphasizes the importance of learners engaging directly with objects and materials, which aligns with Millar (2004), who argues that practical work is essential for developing scientific skills through direct manipulation and observation. Teacher B and Teacher C's focus on laboratory experiments under teacher guidance supports Abrahams and Millar's (2008) assertion that practical work helps in the application of theoretical knowledge in a controlled environment. Teacher D's description of practical work as experimental, hands-on activities reflects Hodson's (1990) view that such activities are crucial for stimulating learners' curiosity and enhancing their understanding of scientific concepts.

These interpretations align with existing research that underscores the value of practical work in science education. Abrahams and Reiss (2012) found that practical work effectively engages learners and promotes an immersed understanding of scientific principles. Similarly, Wellington (1998) argues that hands-on experiments are vital for bridging the gap between theoretical knowledge and real-world applications. However, some researchers, like Osborne (1998), cautioned that without proper guidance and context, practical work might not always lead to meaningful learning outcomes. To this end, teachers' definitions of practical work resonate with the broader educational consensus that practical work is a fundamental component of effective science teaching.

Theme 2: The Status of Practical Work at School

Teachers were asked about the status of practical work at their school and below are their responses:

According to Teacher A:

"*Not much practical work is done at our school; especially at Junior Secondary level where I teach because there's only one lab and it has little equipment".*

In addition, Teacher B has also retorted that:

"It is not the best; practical work is done only by senior learners".

Furthermore, Teacher C says that:

"Practical work is not really done at our school; it is only few experiments that are carried out for Grade 11 learners".

Lastly, Teacher D responded to the question by saying that:

"*The status of science workout our school is not good as it should be. Complex experiments are not done, because the necessary equipment needed for experiments are not found in our science laboratory".*

The findings from this study highlight the limited implementation of practical work in schools, primarily due to inadequate laboratory facilities and equipment. Teacher responses revealed that practical work is scarce, especially at the Junior Secondary level, with only a few experiments conducted for Grade 11 learners. This aligns with the findings of Lunetta, Hofstein, and Clough (2007), who emphasize that the lack of proper laboratory facilities and materials significantly hinders the effective teaching of science practical work. Similarly, Millar (2004) noted that practical work is often disregarded in science education due to resource constraints, which limits learners' hands-on learning experiences. The responses of the teachers in this study are consistent with these observations, indicating a pressing need for better-resourced laboratories to facilitate comprehensive science practical work.

Theme 3: Preferable Teaching Methods in Physical Science

Teachers were asked about their preferred teaching methods in Physical Science and

Below are their responses:

According to Teacher A:

"I prefer using both methods so that learners in theory then do practical work to understand theory much better".

In addition, Teacher B has also retorted that:

"All methods, learners will learn in theory and then practice what they learn by conducting experiments in the laboratory. This helps them in retaining the content much better".

Furthermore, Teacher C says:

"I prefer using mixed teaching methods, theory and then practical work to accommodate learners because learners learn best when they see things happening".

Lastly, Teacher D responded to the question by saying:

"Both practical and theoretic methods, because learners learn differently using both methods will befit learners more".

Based on this theme, teachers in this study preferred a combination of theoretical and practical teaching methods, as this approach helps learners understand and retain content more effectively. This preference is echoed by Hofstein and Lunetta (2004), who argue that integrating theory with practice enhances learners' understanding of scientific concepts and processes. Additionally, Abrahams and Millar (2008) support the use of mixed teaching methods, noting that practical work allows learners to apply theoretical knowledge, thus reinforcing their learning. The teachers' preference for a mixed approach aligns with these findings, suggesting that a balanced integration of theory and practice is beneficial for effective science education.

Theme 4: The Frequency of Carrying out Practical Work in Physical Science

Teachers were asked about how often they carry out practical work in Physical Science and below are their responses:

According to Teacher A:

"At the phase where I am teaching, we do not carry out practical work at all".

In addition, Teacher B has also retorted that:

"practical work is not carried out often; it is only carried out for a number of experiments for Grade 11 learners".

Furthermore, Teacher C says that:

"Not very often, experiments are only done at the end of the semester".

Lastly, Teacher D responded to the question by saying that:

"Not so often, because only selected experiments are done, and it is mostly done by the end of the semester so that it can be done in one week".

The study revealed that practical work in Physical Science is infrequent, with experiments often conducted only at the end of the semester or not at all. This infrequency is primarily due to limited resources and time constraints. Abrahams and Reiss (2012) found similar issues, reporting that practical work in science is often limited due to a lack of equipment and sufficient time allocated for laboratory activities. Furthermore, Dillon (2008) highlights that logistical challenges and curriculum pressures frequently lead to the reduction of practical work in schools. The findings of this study align with these observations, indicating a need for more frequent and regular practical work to enhance learners' scientific skills and understanding.

Theme 5: Challenges Faced when Conducting Practical Work in Physical Science

Teachers were asked about the challenges that they faced when conducting practical work in Physical Science and below are their responses:

According to Teacher A:

"The challenges being faced at our school are that we only have one laboratory, and it has very few types of equipment, therefore we do not carry out practical work in Grades 8 and 9".

In addition, Teacher B has also retorted that:

"Limited working space and time, material are the main challenges we faced in Physical Science practical work. Some learners are not motivated as they have negative attitude towards practical work in science subjects".

Furthermore, Teacher C said that:

"Experiments are done in groups of more than two because there are only a few pieces of equipment in our laboratory, and it does not correspond with the number of learners".

Lastly, Teacher D responded to the question by saying that:

"lack of equipment, learners work in groups of four to five to carry out an experiment and some do not get a chance to participate actively due to that" Some learners do not have a background knowledge on how to carry out practical work in Physical Science.

Teachers identified several challenges in conducting practical work, including insufficient laboratory space, limited equipment, and a lack of student motivation. These challenges are consistent with findings by Osborne and Dillon (2010), who noted that inadequate laboratory resources and negative learner attitudes towards science can impede effective practical work implementation. Additionally, Hodson (1993) discussed the issue of overcrowded classrooms, which can prevent learners from actively participating in experiments.

Theme 6: Strategies to Reduce the Challenge Faced During Practical Work in Physical Science

Teachers were asked about the strategies that can be employed to reduce the challenges faced by teachers and learners during practical work in Physical Science and below are their responses:

According to Teacher A:

"A suggestion I would give is for the government to find the building of another laboratory at our school because we only have one at a moment and it is not fully equipped".

In addition, Teacher B has also retorted that:

"The problem can be addressed by engaging stakeholders and requesting them to invest in buying laboratory equipment for the school. Our school needs a laboratory technician to assist in servicing malfunctioning equipment".

Furthermore, Teacher C says that:

"The school can request for more laboratory equipment from the government and other educational stakeholders. Provision of sufficient material for Physical Science such as book will reduce the challenges".

Lastly, Teacher D responded to the question by saying that:

"The challenges can be overcome by requesting for assistance from educational stakeholders to buy more laboratory equipment".

To address the challenges faced in practical work, teachers suggest increasing government and stakeholder investment in laboratory facilities and equipment, as well as hiring laboratory technicians. This recommendation aligns with Hofstein and Lunetta (2004), who advocate for greater investment in science education infrastructure and continuous professional development for teachers. Furthermore, Tobin (1990) emphasizes the importance of support from educational stakeholders in providing the necessary resources for effective practical work. The strategies proposed by the teachers in this study resonate with these findings, highlighting the need for a collaborative effort to improve the quality and frequency of practical science education.

Mitigating Challenges Experienced in the Implementation of Science Practical Work

To mitigate challenges in the implementation of science practical work, teachers need comprehensive knowledge beyond the curriculum to facilitate hands-on activities effectively. Dayal and Ali-Chand (2022) emphasized that understanding the accomplishment of practical work allows teachers to prepare necessary supplies and set up experiments. Support from school management is crucial, as Bernholt et al. (2019) suggested securing budgets and organizing fundraising events for procuring equipment in necessary for school leaderships in the absence of traditional laboratory facilities. Additionally, Senior Education Officers (SEOs) at the Advisory Services and Heads of Departments (HoDs) should assist teachers in planning and preparation of science practical work especially for novice and teachers at resource-constrained resources (Kapici et al., 2020).

Continuous professional development is essential for teachers to enhance their skills in conducting practical work, as recommended by Babalola et al. (2020). Conferences and capacity-building workshops organized by the Ministry of Education can provide training and opportunities to exchange experiences (Kasiyo et al., 2017). The presence of laboratory technicians is vital, as they possess specialized knowledge and skills crucial for effective laboratory practices (Babalola et al., 2020; Angeles et al., 2023). However, in many African schools, the absence of technicians' forces teachers to juggle dual roles, compromising the quality of laboratory instruction (Hadji & Marasigan, 2020; Mesler et al., 2021).

The practical implications of this study are significant for teachers, policymakers, and stakeholders in the education sector. By addressing the identified challenges, such as inadequate laboratory facilities and limited equipment, schools can improve the quality and frequency of practical work in science education. Implementing the suggested strategies, such as increasing investment in laboratory resources and fostering collaborations between schools, can enhance the learning experience for students and better prepare them for future scientific endeavours.

4. CONCLUSION

The main findings of this study revealed that the status of science practical work at the school is significantly hindered by the lack of adequate resources and apparatus, including laboratory equipment. Other contributing factors include limited working space in the laboratory, insufficient time allocation, overcrowded Physical Science classrooms, lack of motivation among both teachers and learners, and inadequate background knowledge on practical activities. To address these challenges, the study suggests the following strategies: provision of sufficient materials, construction of an additional laboratory, and employment of laboratory technicians. Moreover, it can also be recommended from this study Physical Science teachers should link with other schools in terms of utilizing neighbouring school's laboratories for conducting practical work, as indicated by Key Area 7 of the National Standards and Performance Indicators for Schools in Namibia.

The findings of this study contribute to the existing body of knowledge by providing a detailed account of the challenges faced in implementing practical work in resource-constrained environments. These results underscore the importance of targeted interventions and resource allocation to enhance the quality of science education. While this study provides valuable insights into the status of Physical Science practical work, it is important to acknowledge certain limitations. The research was conducted at a single secondary school, which may limit the generalizability of the findings. Additionally, the qualitative approach, while providing in-depth understanding, may not capture the full extent of the challenges faced across different schools and regions.

Addressing these limitations enhances the credibility of the findings and sets the stage for future research to build upon this work. To address the challenges identified, several potential solutions were suggested by the participants. These include increasing government and stakeholder investment in laboratory facilities and equipment, constructing additional laboratories, and employing laboratory technicians to assist teachers. Additionally, fostering collaborations between schools to share resources and facilities can mitigate some of the resource constraints. Future research could explore the effectiveness of these solutions in improving the quality and frequency of practical work in science education. Practical applications of these findings could involve policy recommendations and the development of targeted intervention programs to support resource-constrained schools.

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