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CHALLENGES PREVENTING SCIENCE TEACHERS FROM PERFORMING NATURAL SCIENCE PRACTICAL WORKS IN SELECTED PRIMARY SCHOOLS IN THE OSHANA REGION, NAMIBIA

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ABSTRACT: *Despite the importance of practical work, there are several factors preventing science teachers, especially at primary schools from including practical work in their teaching routine. The main objective of this study was to investigate the challenges preventing science teachers from carrying out Natural Science practical works in selected primary schools in the Oshana Region. A qualitative research approach employing interview schedules and observation as the research instruments was used to collect data on the challenges faced by the science teachers. A sample of 4 Natural Science teachers (2 teaching grade 6 and 2 teaching grade 7) was chosen using the purposive sampling method to participate in the study. The study found that the major factors preventing the teachers from carrying out practical works in the selected primary schools include lack of well equipped functional laboratories, no provision for practical work on the teaching time table, teachers' lack of experiences in preparing experiments and handling of some equipment, and the lack of laboratory assistance. However, as part of measures to encourage the use of practical works in teaching primary school Natural Science in the study area, the participants indicated that relevant materials and equipment should be made available at the beginning of every academic year. It was also indicated that regular capacity building workshops should be held to train the teachers on conducting experiments and handling equipment. Thus, it was recommended that the school management should devise means of addressing the identified challenges in order to enable the teachers include practical work in the teaching of Natural Science.*

KEYWORDS: *Practical work, Natural Science, challenges, apparatus, laboratories*

INTRODUCTION

Practical work is an important component of science teaching, which provides learners with the opportunity to observe physical phenomena, touch and manipulate equipments, manage instruction, and enhance the learning of scientific skills. As stated by Hodson (1990), practical work gives insight into scientific methods and develops expertise in using it. It also develops scientific attitudes such as open mindedness and objections (Hodson, 1990). According to Duggan and Gott (1995), "practical work is useful in developing reasoning skills and encouraging observations and providing direct contact with the physical world". Apart from helping learners to observe and discover things, practical work provides basis for comparison, testing, and developing critical science experiences. As noted by Woodley (2009), most practitioners would agree that good quality practical work could engage students, help them to develop important skills, help them to understand the process of scientific investigation, and develop their understanding of concepts. When done well, practical work can stimulate and engage students' learning at different levels, challenging them mentally and physically in

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ways that other science experiences cannot (Score, 2009b). According to Millar (2002), a good question to consider before planning to carry out any practical activity is: What do I expect the students to learn by doing this practical task that they could not learn at all, or not so well, if they were merely told what happens? In his article titled "Practical work in school science – why is it important?", Woodley (2009) opined that if the goals and objectives of practical works are not expressed in terms of being able to apply scientific knowledge, understanding and skills, there is a danger of students simply following 'recipes' during practical activities. This does not produce sustainable and helpful learning that the learners can apply to solve problems in the wider world.

In performing practical works at schools, there could be various challenges, which might affect the achievement of the exit learning objectives. For example, Klanin (1988) had observed some challenges, which are mainly associated with curriculum implementation namely, the lack of equipment, insufficient timetable time for practical work, lack of safety precautions in the laboratory and learners' participations. There were other reported problems associated with incentives, which include the value of practical work held by students, teachers and curriculum developers and lack of reward for the students (Nghipandulwa, 2011). Kim and Tan (2011), were of the opinion that practical work is regarded as one of the most challenging task for science teachers and thus, not practised frequently or efficiently in many science classrooms. The authors identified various reasons for teachers' unwillingness to conduct practical works namely, lack of external support, large number of students, availability of resources, and the absence of trained laboratory assistance. According to Zoldosora and Prokop (2006), the issues of health and safety, risk management and cost are among the significant factors limiting fieldworks.

As stated by Millar (2004), the aims of science education might be summarized as follows: i. To help students to gain an understanding of as much of the established body of scientific knowledge as is appropriate to their needs, interests and capacities. ii. To develop students' understanding of the methods by which this knowledge has been gained, and our grounds for confidence in it (knowledge about science). The second of these is often referred to as 'understanding the nature of science', and encompasses elements of science both as an enquiry process and as a social enterprise (Millar, 2004). As also reported by Millar (2004), the school science curriculum in most countries has two distinct purposes: first, it aims to provide every young person with sufficient understanding of science to participate confidently and effectively in the modern world – a 'scientific literacy' aim; second, advanced societies require a steady supply of new recruits to jobs requiring more detailed scientific knowledge and expertise – school science provides the foundations for more advanced study leading to such jobs. These two purposes may lead to different criteria for selection of curriculum content, to different emphases, and to different rationales for the use of practical work (Millar, 2004).

The Namibia's Ministry of Education (MoE) provided the following learning and assessment objectives in the primary school Natural Science: i. To acquire knowledge with understanding. ii. To handle information, apply knowledge and solve problems. iii. To acquire pactical, experimental and investigation skills and abilities. These objectives imply that practical work is an indispensable component of the teaching and learning of Natural Science at the primary school level. During practical work, learners perform different activities, which may improve their abilities to handle equipment, process information, solve problems and

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develop scientific skills. Despite the obvious lack of practical work in the teaching of primary school Natural Science in the Oshana Region, there is no documented research on the factors that prevent science teachers from conducting practical work. Therefore, the main purpose of this study was to investigate the challenges preventing Natural science teachers from conducting practical works when teaching Natural Science at primary schools in the Oshana region. The study is guided by the following research questions:

1. What are the challenges preventing science teachers from conducting Natural Science practical works in selected primary schools in the Oshana Region?
2. What are the views of the teachers on how Natural Science practical works can be improved in the Oshana Region?

Thus, the study provided important baseline data on the challenges preventing primary school Natural science teachers from conducting practical works when teaching Natural Science in the study area and the teachers' views on appropriate mitigation measures that could be used to address the identified challenges.

THEORETICAL FRAMEWORK

This study was guided by experiential learning theory of Kolb who looked at experiential learning as learning from experiences. Kolb defined learning as "a process whereby knowledge is created through the transformation of experience and it involves the gaining of abstract concepts that can be applied well in a variety of situations" (McLeod, 2017). Kolb's experiential learning theory is a holistic perspective that combines experience, perception, cognition and behaviour. There are four stages of learning cycle that represent Kolb's experiential learning theory as explained by David (2007) and learners touch them all. These stages include: (1) concrete experience whereby a new experience is encountered or reinterpretation of existing experience. (2) Reflective observation of new experience of particular importance and any inconsistencies between experience and understanding. (3) Abstract conceptualization reflection gives rise to a new idea, or a modification of an existing abstract concept. (4) Active experimentation whereby the learner applies them to the world around them to see what results (David, 2007). These stages emphasised the important role experience plays in the learning process. The theory proposes that learners need to be actively involved in the experiments and reflect on the experiments for them to gain knowledge from it and be able to apply what they learned in the real world.

METHODOLOGY

Research Design

This study follows the qualitative research approach as a case study design. Gay et al. (2011) defined a case study research as a qualitative research approach in which researchers focus on a unit of study known as bound system. In this case, the qualitative case study design was used to explore the respondents' experiences of the challenges preventing Natural Science teachers from conducting practical work in selected primary schools in the Oshana Region and the views of the teachers on the measures that could be used to address the identified challenges.

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

Sample and sampling procedures

De Vos and Strydom (2015), defined sample as the elements of the population considered for actual inclusion in the study. Thus, the sample of this study consisted of 4 Natural Science teachers selected using the purposive sampling method from two primary schools in the Oshana Region.

Research instrument and data collection

The study used two types of research instruments: interview schedule and observation to collect data.

Interview: An interview guide containing open-ended questions was used to explore the challenges preventing Natural Science teachers from carrying out practical works when teaching Natural Science in the two selected primary schools in Oshana Region. The researchers made separate appointments to hold face to face interview with the individual teachers. During the interview, open-ended questions were asked to explore the teachers' experiences of the challenges preventing them from carrying out practical works when teaching Natural Science in the selected schools. Open-ended questions were also asked to explore the teachers' views on measures that could be used to address the identified challenges and make it possible for them to carry out the practical works as indicated in the Natural Science syllabus. All the interviews were recorded using Sony ICD-UX560 digital voice recorder and the information was transcribed.

Observation: This method was used by the researchers to personally observe live lessons in Natural Science class and obtain first-hand information on the challenges that are preventing the science teachers from conducting practical works in the selected schools. During the observations, the researchers looked attentively at the challenges preventing the Natural Science teachers from conducting practical works in the two primary schools. The researchers observed three different Natural Science lessons classes in each school and took note of the challenges the teachers encountered during the teaching. The researchers also observed the equipments and other facilities available for conducting practical works in the schools and took note of them.As part of the research ethics, the researchers duly obtained permission letters from the selected schools' principals to carry out the study. The purpose of the study was clearly explained to the participants (Natural Science teachers) who were also assured of their confidentiality and right to withdraw from the study at any point. After clarifying the issues raised by the participants, the researchers handed them consent letters, which they signed to participate in the study voluntarily.

Data Analysis

The researchers first checked the research instruments for completeness after gathering data from the field. Then, the contents were organised and categorised according to the emerging themes based on the research questions

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RESULTS AND DISCUSSIONS

Q in the following the results and discussions present below refers to question while T_A, T_B, T_C and T_D refer to Teachers A, B, C and D respectively.

Challenges Preventing Science Teachers from Conducting Natural Science Practical Works in Selected Primary Schools in the Oshana Region

Findings from the interview

Q1. What do you understand by the term practical work?

This question aimed to find out how different teachers view and understand practical work in the context of teaching Natural Science. Teacher A (T_A) viewed practical work as a teaching method where learners are more involved and the teacher is there to guide them. T_A further explained that practical work could be done outside or inside the classroom depending on the type of experiment. Teacher B (T_B) understood practical work as a way of teaching whereby hands-on activities are involved. Teacher C (T_C) said practical work is a teaching method based more on learner-centred and less on teacher-cantered method of teaching. T_C further explained that during practical work, the teacher only gives instructions to learners on what to do and the learners will follow the instruction given to complete the activity.

Comparing the responses of these teachers, the researchers opined that all the teachers that participated in the study understood the concept of practical work in Natural science teaching. Nghipandulwa (2011), defined practical work as a component of science teaching that focuses on investigating phenomenon through hands and minds inquiry. This method of teaching engaged learners in real life situation through observation, investigation, teachers' demonstration, and designing objects or materials they are studying. As stated by Millar (2004), finding things out for yourself, through your own efforts, seems natural and developmental, rather than coercive, and may help you to remember them better. Given that the subject matter of science is the material world, it seems natural, and rather obvious, that learning science should involve seeing, handling and manipulating real objects and materials (Millar, 2004). According to Woodley (2009), effective practical activities enable students to build a bridge between what they can see and handle (hands-on) and the scientific ideas that account for their observations (brains-on).

Q2. How often do you carry out practical work in Natural Science?

This question aimed to find out if teachers make use of practical work in their teaching schedules as recommended by Natural Science curriculum. The participants' responses revealed that T_A did conduct practical work in each lesson that needs practical work/investigation. T_B said it depends on the basic competence in the syllabus; the syllabus has indicated the topics to be taught practically although, this could be affected by the availability of materials. In the follow up interview, T_B, asserted: "even if the syllabus has indicated that the topic should be based on practical works and there are no materials available, then you have to teach theoretically". T_C said that carrying out practical work will depend on the learning objectives of the chapter while T_D said, it depends on the topic being taught. T_D further added that "some topics are easy to understand by just explaining the

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concept theoretically but some topics are difficult for learners to understand by just explanation and so, practical work needs to be engaged for learners to understand better."
During the lessons' observation, the researchers observed that most of the teachers do not engage learners in practical works to enable them relate the concepts learned to real life understanding. Said (2015), in an article titled "the importance of practical activities in school science", stated that
"teachers everywhere are under pressure to raise the academic achievement of students by producing high grades in national and international tests, but they (teachers) are unable to implement enough and high quality practical work that learners should experience to enhance their knowledge and improve their skills required for high academic achievements".
Teachers should raise practical work because it helps teachers make learning more engaging and interesting. When learners are engaged and interested in the teaching activities, better learning and understanding take place.

Q3. As a teacher, do you prefer teaching using practical or theoretical method? Give reason(s)

This question aimed to find out the teaching method teachers mostly use in their teaching process and this question also helped the researchers to identify the attitudes of teacher towards practical work by asking them to give the reason(s) why they chose a specific method of teaching. The participants' responses revealed that T_A and T_C prefer both lecture and practical methods and they always choose how to teach the lesson depending on the topic. T_B said she prefer practical works because learners enjoy doing things by themselves rather than the teacher explaining and demonstrating. T_D said she prefer teaching theoretically because she believes that "teaching using the practical method takes much of the time and at the end of the term, the content is not fully covered." According to T_D, the theoretical method is fast as long as learners are given notes to study.
The findings here suggest that there are still some teachers who have negative attitudes toward practical work. It was stated by Duggan and Gott (1995), that a teacher's belief or conception of practical work can impact directly on the way she/he arranges practical work. Nghipandulwa, (2011) added that teachers should have a clear understanding of what practical work entails and the purpose it serves. Having a clear understanding about the nature of practical work might help the teachers to plan teachable practical activities.

Q4. Is there specific time allocated on your time table for practical work in Natural science? If yes, is the time allocated to practical work sufficient?

The question aimed to find out if there is a separate time table slot for practical work in the primary schools and if the teachers make use of the slot as indicated in the time tables. Responding to this question, T_A said that there is no specific time allocated for practical work on the time table and so conducted practical work in the afternoons during study sessions. Therefore, for T_A, time is always enough to complete the practical works. T_B responded by saying there is no specific time allocated for practical work on the timetable, the time allocated for both practical work and theoretical is not specified on the timetable. T_C said, the time is not specified on the timetable, simply because not all chapters in Natural Science require practical works. T_D responded by saying "the timetable is made up in such a way that, in every week there is a double lesson in order to make use of it for practical works".
From the observation of the lesson time table, the researchers found that lesson time tables in the two primary schools have provisions for single lesson and double lesson every week. However, the responses of the majority of the participants (science teachers) indicated that

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they are not aware of the purpose of the double lessons on their lessons' time tables. Out of the four respondents, only one teacher understood the purpose of the double periods slotted on the lessons' time tables. Nghipandulwa (2011), in her study quoted the National Subject Policy Guide for Natural Science that said "Natural science is one of the subject that require practical; consecutive periods (a double period) on the school time table could provide enough time for practical activities. Single lessons were supposed to be used for theoretical lessons".

Q5. Are there laboratories dedicated for conducting practical work in Natural Science in your school? If no, state the place where you carry out practical work with your learners.

This question aimed to identify if the science teachers face challenge of laboratories where they can conduct practical works in Natural Science. In the Natural Science syllabus, some of the recommended practical works or investigations need to be carried out in the laboratory. The question also aimed to find out if the availability or otherwise of laboratory has effect on conducting practical works in the schools.

In their responses, T_A indicated that there is a laboratory dedicated for conducting practical work in Natural Science but the laboratory is not in good condition. Thus, most of the time, T_A performed practical activities in classroom and do not make use of the laboratory. T_B said that there is a laboratory, but since the laboratory is not in good conditions, they carry out practical works in the classroom or outside depending on the type of experiment. T_C said they do not have a laboratory but used any free place for practical activities depending on the learning objectives. T_D added by saying there is no laboratory; practical works are carried in the classroom, although the classrooms are not conducive for practical works. T_D further added that in the classroom, an experiment or practical set up can be destroyed anytime. As noted by Kasiyo et al. (2017), the lack of science laboratories in schools is a serious blow since some activities cannot be conducted in class for the safety of the learners and for the safety of apparatus. Availability of physical resources (e.g. laboratories, science apparatus or portable laboratory stations) is a challenge that prevents teachers from conducting practical works (Kasiyo et al., 2017).

Q6. Do you have the needed equipment and apparatus to conduct Natural Science practical works? If No, what do you to carry out experiments where needed equipment and apparatus are not available or are inadequate?

This question aimed to find out if the primary schools have enough equipment to enable science teachers effectively conduct Natural Science practical works. T_A responded by saying that they do not have adequate apparatus for practical works but often times, he made alternative arrangement such as creating own apparatus (e.g. containers) where possible and by borrowing other things like chemicals from neighbouring schools. T_B said there are no equipments and apparatus in his school; what they often do is that they read the competence in advance and ask learners to bring local materials to represent the apparatus, or the teacher can buy some affordable items (e.g. sticks of candle) needed in the practical work. T_B further added that sometimes, they borrow equipment from neighbouring schools to use and return them back after the experiment. T_C indicated that they have enough tools for practical, but only recently acquired. T_D also said that the school has just received new apparatus and equipments recently, which are now available, but they are not trained on how to use the equipments and so, they do not know how to use some of them.

The participants' responses suggested that there might be some primary schools in the Oshana region that do not have instruments for conducting practical works. Without the necessary

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equipments and apparatus, teachers might not allow learners to do practical works and handle the apparatus on themselves but may rather demonstrate to learners or teach only the theory component of the topic. This might prevent teachers from carrying out all the practical works stipulated in the syllabus, which in turn will disadvantage the learners in the Alternative to Practical Work examination paper (Nghipandulwa, 2011).

Q7. Do learners benefit from your practical lessons?

The question aimed to find out the teachers 'view of whether practical works are beneficial to the learners. T_A said learners really benefit from practical work as they experience what they have learnt in real life. According to Teacher A, learners get in-depth knowledge when they see the true processes. T_B indicated that not all learners benefit from my practical works. However, some learners that took advantage of practical lesson and made it their time to discuss their personal issues and walk around in the class. T_C responded that learners benefit from practical lessons because that is where learners gained a lot of knowledge, as practice makes perfect. T_D also indicated that learners do really benefit from practical lessons because learners remember better, what they have seen rather than what they heard.

As Said (2015) rightly stated, practical lesson in science is widely accepted as a vital component of teaching and learning. The author further stated that, it is an effective way to enhance students' motivation and extend their knowledge in understanding theories and ideas about the natural world. Learners prefer practical work than many other learning methods, but for the practical work to be beneficial to learners, it should involve both learning and assessment which meet the objective of what learners are expected to learn and learners should also understand the aim of the practical work.

Q8. Do you think practical lessons are needed in Primary School Natural science? Please give reason(s)

The aim of the question was to find out from teachers on how they feel about practical work; do they feel practical work should be included in Natural Science teaching at the primary school level? In their responses, T_A opined that practical lessons are needed in the teaching of Natural Science at the primary school level as most of the topics need to be understood theoretically and practically. Learners also learn better through experiments and it is always interesting as learners are always curious to see the real life context of what they have learned. T_B indicated that practical lessons are needed in the primary school Natural Science in order to prepare the learners for future and equip them with the knowledge that will connect them to real life situation. T_C also responded that practical lessons are needed to teach specific practical skills, such as measurement and observation, which may be useful in future study or employment. T_D stated that practical work plays a very important role in learning and added that, if learners are more engaged in practical work and they understand the aim of it, they will understand the content better and improve in their performances. T_D concluded by saying that practical work is very important and needed in Natural Science.

The findings here revealed that, the teachers understood the importance of practical work in science and they all acknowledged that practical lessons are needed in science. Practical work can increase the interest of learners in science and motivate them to pursue future careers in science.

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Q9. What are the factors that are preventing you as a teacher from conducting practical work in Natural Science?

Responding, T_A indicated that he is constrained by challenges such as lack of apparatus and materials, as well as the environment that the school finds itself in, including the weather. T_A further added that there are some practical works that ought to be conducted in winter but you find the topic earmarked for summer and this affects the practical work. T_B mentioned that factors such as availability of teaching materials and time allocated to practical teaching are not enough since most of the topics in Natural Science require practical works; the competencies that require practical work are a lot and teachers will not be able to finish them within the terms. T_B also identified lack of laboratory and laboratory assistance at the school. T_C said the time allocation is a barrier to practical work because practical work consumes time. T_D identified the lack of learners' interest and poor attitudes. The teacher also asserted that some of the practical works are difficult to be understood by teachers and as a result, they end up not doing them because teachers do not have the knowledge or experience.

These findings suggest that the primary schools Natural science teachers in the Oshana Region are facing various challenges in conducting practical work in their respective schools. Said (2015), identified the top barriers to effective delivery of practical work to include: time constraint due to length of curriculum, lack of necessary equipment and materials, insufficient technical support, lack of students interest and attitude, lack of teachers' experience in practical delivery, assessment and tests required.

Views of the teachers on how Natural Science practical works can be improved in the Oshana Region

Q10. What do you think could be done to overcome the challenges preventing you from conducting practical works in Natural Science?

The question aimed to establish the views of the teachers on what they think need to be done in order to address the challenges they are facing and preventing them from carrying out practical work in Natural Science. T_A suggested that all the materials specified by the subject syllabus need to be purchased and available at the beginning of every academic year. T_A also added that the people responsible for drawing the academic calendar and scheme of works should ensure that certain topics with practical works that might be affected by weather are allocated within the right time of the year. T_B suggested that capacity building workshops on how to improve practical works in natural science should be organised regularly for the teachers. T_C suggested that schools should be provided with well-equipped practical laboratories. T_D stated that the teachers need to be trained on how to carry practical work. These findings suggest that the Natural Science teachers faced several challenges preventing them from carrying out practical works in their teaching in the Oshana Region, which require appropriate intervention measures to address the challenges. Kasiyo et al. (2017), in their study suggested that the Ministry of Education should bring more training through workshops to equip teachers with more knowledge on how to use practical teaching strategies. By doing so, the Ministry of Education will build a good foundation in Natural Science teaching at primary school level in the Oshana Region.

Results from observations

It was observed in one of the schools (School 1) that there was a laboratory but the laboratory design was inappropriate for the practical works conducted in the school. The laboratory does

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not have chairs for learners to sit when conducting practical works. In addition, the power sockets were not working; the tables used as work benches were broken and constitute injury risks to learners. In addition, the water taps in the laboratory were not working properly. The laboratory was dirty and dusty indicating that it had not been used for a long period. In school 2, there was no laboratory at all and the teachers performed experiments in classrooms even though the classes were not organised to make it suitable for conducting practical works. The classrooms were too small for learners to work freely and interact with one another during the practical work. For effective learning to take place, classroom environment should be conducive to learners. Without proper classroom setting, it may be impossible for the learners to concentrate on the given task and achieve the lesson objectives. Therefore, the schools' laboratories or classrooms used for carrying out practical works in the Primary schools need to be in good condition suitable for learning to take place.

It was also observed in School 1 that the resources needed to support practical lessons were not enough and some of the available resources were old and broken. In School 2 however, there were enough resources and most of them were new but they were locked in the office and not available for use most of the time. It was gathered that the teachers do not make use of the apparatus or laboratory equipments because they do not know how to operate or use them and there was no laboratory assistant in the school to assist the teachers in planning and conducting practical works.

CONCLUSION

The findings of this study revealed that the Natural Science teachers in the selected primary schools in Oshana Region faced several challenges, which are preventing them from using practical works in teaching Natural Science. Notable among the identified challenges include the lack of well-equipped functional laboratories, lack of defined practical lesson's time slot on the lessons' timetable, teachers' lack of experiences in conducting practical works and handling of some equipments, and the lack of laboratory assistance. These conditions often made the teachers to use the theory method rather than practical work in teaching Natural Science at the schools. However, as part of measures to encourage the use of practical works in teaching Primary school Natural Science in the study area, the teachers indicated that relevant materials and equipments should be made available at the beginning of every academic year. Furthermore, it was indicated that capacity building workshops on improving and conducting practical works in Natural Science should be organised regularly for the teachers. Thus, meaningful efforts should be directed towards addressing the identified challenges in order to motivate the teachers to include practical works in their teaching of Natural Science.

RECOMMENDATIONS

Based on the findings of this study, the following were recommended in order to address the challenges preventing science teachers from conducting practical works in Primary Schools in the Oshana Region:

✓ The primary schools should be provided with well-equipped laboratories and the necessary materials specified in the subject syllabus should be provided for use at the beginning of ever academic year.

Print ISSN: 2054-6297(Print), Online ISSN: 2054-6300(Online)

✓ There should be a laboratory assistant at the schools to help with the planning and conduct of practical works.
✓ A clear timetable provision should be made for carrying out practical works in the schools. This should be evidently clear to all learners and teachers.
✓ The people responsible for drawing the schools' academic calendar and scheme of works should ensure that topics with practical works that might be affected by weather are allocated within the right time of the year.
✓ Capacity building workshops and conferences should be organised on a regular basis where science teachers are trained and can share experiences on how to use equipment and conduct certain practical lessons in Natural Science.

IMPLICATION FOR FURTHER RESEARCH

The findings of this study has shown that there need to replicate this study in the other regions of Namibia with the view to establishing the challenges preventing Natural Science teachers from conducting practical works at the primary school level. This will help to generalize the countrywide findings and to take the desired measures.

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