Secondary school teachers' perceptions of practical work in Biology in the Oshana Educational Region

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Abstract
The aim of this study was to investigate the Biology teachers' perceptions of the importance of practical work in selected secondary schools in the Oshana Education Region (OER). The study also sought to find out whether the selected secondary schools in the OER had all the necessary resources needed to conduct meaningful practical lessons in Biology. This study sought to answer the following research questions: What are the Secondary School teachers' perceptions of the importance of practical work in Biology in Oshana Education Region?, and Do Secondary Schools in Oshana education region have all the necessary resources for conducting practical lessons in Biology? This study was situated in the qualitative and quantitative research paradigms. The population consisted of all Biology teachers at Grade 11 and 12 levels in OER. Eight Secondary Schools in the OER were randomly selected to take part in this study. A sample comprising 23 Biology teachers was chosen purposively from the 8 Secondary Schools. A questionnaire and an observation schedule were used to collect the data from the sample.

Descriptive statistics were used to analyse quantitative data and included frequency tables, graphs and pie charts. Qualitative data were categorised into themes that emerged from the data. The findings showed that 69.9% of the Biology teachers did not have a laboratory specifically for conducting Biology practicals and carried out their practicals in a common laboratory, used for both Physical Science and Biology or in their classrooms. Two of the nine teachers observed did not bother to carry out practical work and taught Biology theoretically which disadvantaged learners on Paper 3, alternative to course work paper. The findings also showed that 66.6% of the teachers did not carry out practicals in Biology. They claimed to be doing so, but in actual sense there were not much practical work taking place in those schools. Four out of the six observed teachers were doing demonstrations only.

The findings also showed that the materials necessary for carrying out practical work were not available in the Biology classrooms or laboratories. This was evident from the non-availability of practical manuals for both teachers and learners resulting in the use of teacher made hand-outs. This situation needs to be seriously addressed if practical work is to become popular among the learners and the teachers in the OER in Namibia. The Ministry of Education through Biology Advisory Teachers should seriously address the lack of laboratory space and laboratory resources to ensure the conduct of practicals in schools in the OER. Biology Teachers should be encouraged to borrow materials for conducting practicals from neighbouring schools in cases where their schools do not have the necessary resources for conducting practicals in Biology.

Keywords: *practical work, laboratories, teachers' perceptions, resources*

Introduction

After independence, the Ministry of Education and Culture in Namibia introduced a new educational system, aimed at "reviewing inequality and inequity within the education system" (Ministry of Education and Culture, 1993, p. 5). The main aim of the educational system was to equip students with the necessary knowledge, skills and attitudes that could enable them to enter institutions of higher learning in and outside Namibia and meet the country's social and economic demands.

According to the Ministry of Education (2009a), the examiners' reports on Biology Practical Examination Paper 3 shows that Namibian learners have continued to perform poorly countrywide in comparison to Papers 1 and 2. The examiners' reports further point out

that it is clear from the candidates' answers that only a few schools follow a practical approach to the teaching of Biology. It was against this background that a mixed methods study was carried out in order to find out the perceptions of Biology teachers to practical work in selected secondary schools in the Oshana Education Region (OER). The study also sought to find out whether the selected secondary schools in the OER had all the necessary resources needed to conduct meaningful practical lessons in Biology.

Research questions

This study sought to answer the following questions:

1. How do Biology teachers in Oshana Education Region perceive the use of practical work during instruction?
2. Do Secondary Schools in Oshana education region have all the necessary resources for conducting practical lessons in Biology including the existence of dedicated laboratories?

The findings of this study might help change the attitudes of Biology teachers toward practical work. This might result in learners performing well on Paper 3.

Theoretical framework and literature review

This study was based on the constructivist theory. Constructivists view learning as an active process whereby learners learn to discover principles, concepts and facts for themselves. The instructor and the learners are equally involved in learning from each other (Woolfolk, 2004). Crawford (1996) indicates that social constructivists, such as Vygotsky, emphasize the importance of the learner being actively involved in the learning process so that he/she can construct his/her own understanding. It is believed that learners with different skills and backgrounds need to collaborate on tasks, such as when they are doing practical work in order to arrive at a shared understanding of the truth in a specific field.

The term "constructivist teaching" is commonly used in the teaching and learning environments (Ritchie & Rigano, 1996). The teacher according to the constructivist theory is not seen as responsible for constructing knowledge for the learners but rather is denoted by the many responsibilities given to him/her during instruction in mediating meaning at the inter-mental plane in the classroom. Thus, the teacher's role becomes that of a guide provocateur, creator of opportunity and co-developer of understanding with learners. The instructional practices of the Biology teachers should therefore assist learners to acquire the process skills (Ritchie & Rigano, 1996). Ever since experimental Science was advocated in the sixteenth century (Klainin, 1995), it has been well accepted that practical or empirical work is the major task of scientists. Thus, in order to educate our future leaders in science, there is a widespread belief that students should learn science by doing what scientists do (Klainin, 1995). Learning of Science therefore is seen by most Science educators as likely to be more effective if the child is involved in practical activities and takes an active part in the learning process. Practical work has been a prominent feature of school Science teaching from the late nineteenth century when Science was established as part of the curriculum of schooling in a number of countries (Klainin, 1995).

The curriculum innovation of the 1950s which started in the United States of America and Europe rapidly spread throughout the world and greatly changed the way science was taught. Practical work refers to laboratory activities that include lectures, group experiments, and teacher demonstrations where learners are involved in handling and observing real objects and materials (Millar, Le Marechals, & Tibergnien, 1999). Teachers should therefore provide opportunities for learners to handle materials, observe events, handle observation results and be able to draw conclusions.

In this paper, practical work refers to an activity that promotes active learner participation in learning. This definition does not only mean hands-on activity involving equipment, but also encompasses a range of other ways of working, including teacher demonstration, group discussion of problems and their solutions, interaction between students, and between students and teachers. It may also involve individual activity such as measurement, observation and investigation. Thus practical work can take different forms from experiments to pencil and paper activity

and might take place in the laboratory, class or elsewhere. Namibia has included a practical work component in the teaching and learning of science (Ministry of Education and Culture, 1993). Learners in grades 11 and 12 are expected to do practical work in Physical Science and Biology. In grade 12, learners are assessed on practical skills in Paper 3 which is an alternative to course work in Biology. The inclusion of practical work is clearly stipulated in the Biology syllabus (Ministry of Education, 2009a).

The value of practical work has long been recognized at the secondary school level. Many teachers acknowledge the value of learning by doing rather than just being shown or told (Driver & Braund, 2015). If students can be allowed to do practical work in Biology, then this could help them understand the content better, because students learn better by doing. They will remember better something that they have done with their own hands. This was further emphasized by Hodson (2018) who said that practical work is an essential component of science and vocational subjects teaching. It is therefore advisable that students should be prepared with mastery of the skills required for practical work so that they will be ready for assessment. Hodson (2018) further added that in practical work the candidate performs certain activities in order to discover something as yet unknown, to test a hypothesis or to check an already known fact. In order to perform these activities, the candidate has to learn the skills required for practical work, which includes preparing and performing experiments and processing the results obtained.

Newman (undated, p .2) wrote: "We observed classes who studied chemistry and found that with few exceptions pupils enjoyed what they are doing in the laboratory even if difficulties arose in the procedures or even if students became aware that they didn't understand what was happening, it didn't seem to matter". On the other hand, Woolnough and Allsop (1985, p. 201) noted that, "Many science teachers recognized the importance of practical work. They believed that pupils should have first-hand practical experience in laboratories in order to acquire skills in handling apparatus, to measure and to illustrate concepts and principles". Having first-hand information will allow students to apply the skills acquired during practical work when they become scientists in future. Ramorogo (2010) explored teachers' perceptions of practical work in Biology in secondary schools in Botswana. He found that in large classes, the shortage of laboratories and the lack of laboratory assistants were serious impediments to teachers in involving students in meaningful practical activities. On the other hand, Leach and Paulsen (2015) reviewed the use of practical work in science education in different countries. They found that in many countries, teachers spent or claimed that they spent considerable amounts of time in supervising laboratory work. However, they found that the bulk of science assessment was traditionally non-practical.

Methodology

This research used the mixed methods to collect both qualitative and quantitative data from the respondents. Qualitative inquiry aids the researchers to find out the views of individuals experiencing a particular phenomenon from their point of view (Patton, 2017). One of the strengths of the qualitative inquiry is the active interaction of the researcher with the subjects of the study (Henning, van Kensburg, & Smith 2004). Part of the data in this study was gathered by means of observations, this according to Strauss and Corbin (1998) is a technique normally associated with qualitative methods which involves close contact between the researcher and the research participants. The quantitative inquiry on the other hand relies on the collection of numerical data. It relies on collecting data based on precise measurement using structured and validated data collection instruments (Johnson & Christensen, 2008). In this study the frequency of use of practical work and facilities in schools had been quantified to find out to what extent these hindered the use of practical work in Namibian secondary schools in Biology.

The two research designs were combined in this study in order to understand the social phenomenon from the participants' perspectives. Accordingly, participant observation was used to collect data from the respondents during practical lessons. The quantitative aspect was helpful in finding out about the practical resources such as apparatus and laboratories availability at the selected secondary schools. The population of this study consisted of all 13 secondary schools in

the Oshana Education Region which offered Biology as a subject at Grade 11 and 12 levels. Eight Secondary Schools in the region were randomly selected to take part in this study. A sample comprising 23 Biology teachers was then chosen purposively from the 8 secondary schools. Two research instruments were used to collect data for this study. These were a questionnaire and an observation schedule. Descriptive statistics were used to analyse quantitative data and included frequency tables, graphs and pie charts. Qualitative data were categorised into themes that emerged from the data.

Findings and discussion

The Biology teachers' perceptions of practical work and the conditions of the laboratories in which they carried out the practical work in Biology in the OER are presented in this section of the paper.

Teachers' perceptions of practical work

The development of teachers' favourable attitudes towards science has often been listed as one of the important goals of science teaching. Students enjoy laboratory work in some courses and that it generally results in positive and improved attitudes towards science, and interest in the sciences (Hofstein, 1998).

Table 1: Teachers' perceptions of practical work in Biology

Statement	**Frequency**
Practicals prove theory in Biology, and make Biology an interesting subject	6
Practicals promote learners understanding of the topics better, and stimulate interest in the subject	5
Practicals yield better results in Biology and prepare learners to answer questions in Paper 3 at the national level	2
Slow learners understand the content better; master the content through investigations and observations	3
Learners learn better when they see and touch objects, they don't forget what they saw, and it reinforces the content	4
Learners develop skills on handling and organizing apparatus and materials and following instructions	3

The results in Table 1 show that the Biology teachers in this study were aware of the importance of practical work and what its aims were and why it was necessary in the teaching and learning of Biology. As indicated by Clackson and Wright (1992), Gott and Duggan (1995), and Leach and Paulsen (2015), a teacher's belief or conception of practical work can impact directly on the way she/he arranges practical work. Teachers should therefore have a clear understanding of what practical work entails and the purposes it serves. Having a clear understanding about the nature of practical work might help the teachers to plan teachable practical activities.

Although the teachers viewed practical work as important in the teaching and learning of Biology, the class observations showed that, only nine (39.1%) of the teachers carried out practical work. The rest of the teachers did not do practical work. Some of the reasons given for not carrying out practical work by the teachers were; *"It was time consuming to prepare practical than teaching lessons*", "Practicals prescribed in the syllabus were not familiar to the teacher", and *"Practicals were frustrating especially if equipments were not enough"*.

Teachers were also asked about what their learners did at the end of each practical lesson. Figure 1 presents their responses.

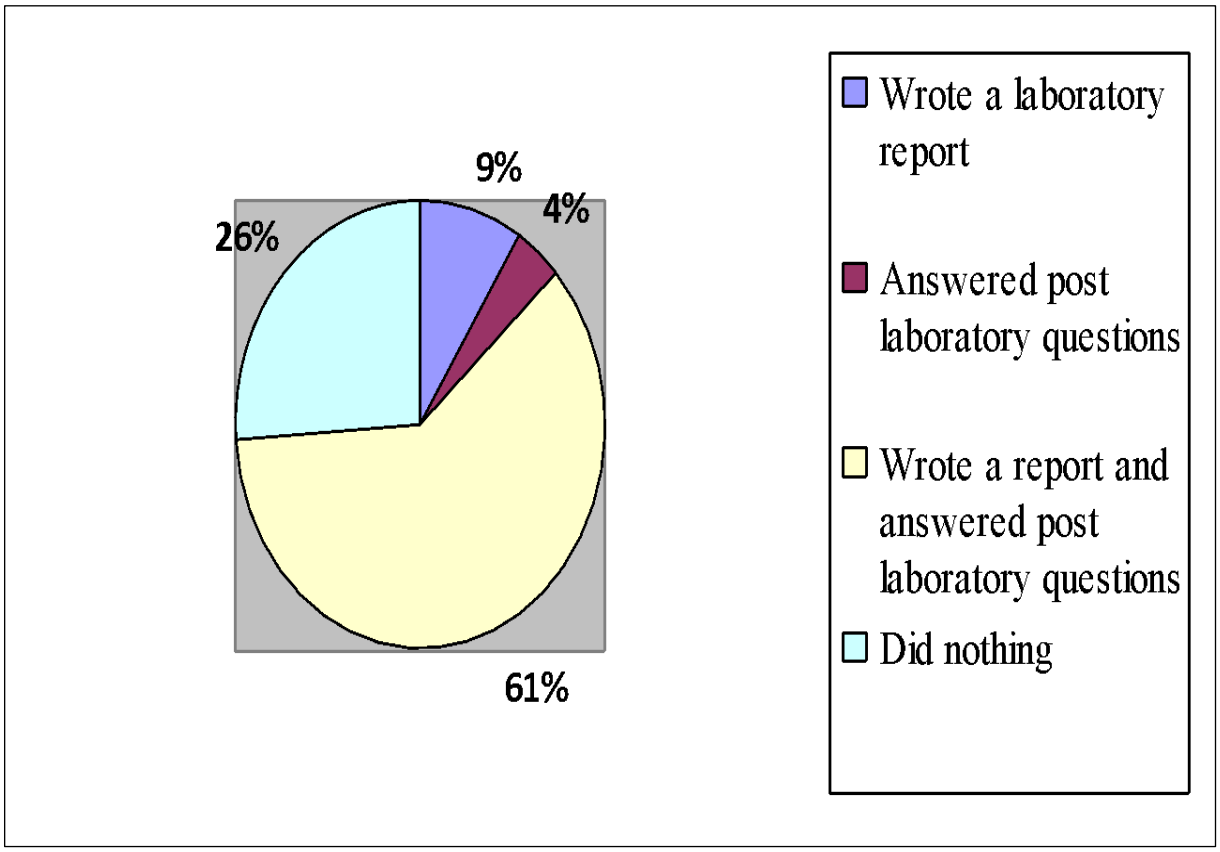

Fig 1: What learners did at the end of each practical lesson (N=23)

Figure 1, shows that one (4%) of the Biology teachers indicated that their learners answered post laboratory questions at the end of the practical lesson. Two (9%) of the teachers said that their learners wrote a practical report, 14 (61%) of the teachers said learners answered post laboratory questions and also wrote a practical report while six (26%) of the teachers, said that their learners did not write anything at the end of the practical lesson. The Ministry of Education (2006, 2007) Examiners' Reports show that practical examinations remained the biggest challenge within the Namibian education system. Learners continued to have problems in performing successfully in practical examinations due to lack of high-level procedural and conceptual skills. The lack of practical assessment of learners after practical lessons could be one of the reasons also. Teachers were further asked to indicate what should be the role of the learners during the practical lesson. Six (26.1%) of the teachers said that it was *"to handle the materials, observe and record their findings"*. Eleven (47.8%) said the role of the learners was to carry out the practical themselves following the right procedures and then answering post laboratory questions. Two (8.7%) of the teachers on the other hand indicated that it was *"to observe teachers demonstrating for them in order to answer the questions, and ask for clarity from the teacher"*. The remaining 4 (17.4%) of the teachers said that *"it was to follow the instructions carefully, write down the results and draw conclusions".* Students need to be involved in practical activities that will enhance their acquisition of higher-order process skills rather than the lower-order thinking skills (Lake, 2004; Savage, 1998).

Sometimes some form of data-handling that was never used in class is examined extensively in the end of year practical examinations (Keiler & Woolnough, 2002). Learners should therefore be active participants during practical lessons. They should do the practical themselves under the teachers' supervision and they should be the ones handling the apparatus during the practical if they are to be successful in the Paper 3

examination. It is interesting to note that, the teachers did not allow learners to do practical work on their own. In six practical lessons observed, the teachers were doing the practical work themselves. In three other cases the teachers used two learners to demonstrate the practical work, while other learners observed. Most of the learners were not actively involved during the observed practical lessons.

Hofstein, Novon, Kipmis, and Mamlok-Naaman (2005) noted that students involved in carrying out a task may perform better than those that were not involved. Therefore, it is important that all learners take an active role during the practical lessons so that they can acquire practical skills. In a country where many learners may not have a scientific background that will help them develop the skill and knowledge of the scientific world, it must be seen as a serious opportunity lost if this experience is not provided in the school environment (Ministry of Education, 2009c).

Presence of resources for carrying out practical work

Existence of laboratory manual and/or materials for carrying out practical work. Theses necessary for successful practical work that will yield desired results. Both teachers and learners need these materials to ensure learning takes place. Accordingly, the Biology teachers were asked to indicate whether these materials existed in their schools for effective carrying out of Biology practical work.

All 23 (100%) teachers indicated that their learners did not have a practical work manual that could guide their work. This was also confirmed during the observations of practical lessons. None of the learners had a laboratory manual. When asked to indicate how they got around the lack of a laboratory manual, the majority (20 out of 23) of the teachers said that they often prepared handouts for their learners to use during the practical and also that they used textbooks as a guide for the practical. In fact, it was found during practical lesson observations that some teachers were using the syllabus as a guide for practical work.

If learners are not given a practical manual, they might not consider practical work to be important in the learning of Science. Preparing practical manuals might save teachers a lot of time and effort, instead of preparing a separate handout for each practical lesson. It might take time for the teacher to write the procedures on the chalkboard, the time that they are supposed to use in order to do the practical with their learners. For those that were using the textbook as a guide for the practical lesson, textbooks might not have clear instructions, and some of the prescribed practicals in the syllabus might not be in those textbooks. The other problem with using the textbooks might be that the books might not be enough for all learners, as most secondary schools do not usually have enough textbooks for all the learners to use as a guide during the practical lesson.

In order to find out the conditions of the place where the Biology teachers carried out practical work in OER, the Biology teachers were asked whether laboratories existed in their schools. Sixteen (69.6%) of the respondents indicated that a laboratory dedicated for the teaching of Biology practicals existed in their schools while seven (30.4%) said they used an ordinary classroom. With respect to the conditions of the laboratories, the respondents' answers are given in Table 2.

Table 2: Conditions of the laboratory for practical work

Condition of laboratory	Frequency
Laboratory was a bit too old without posters to support the practical	2
Big but empty, it does not have stools for learners to sit on, tables not enough, learners standing, benches not enough	2
Laboratory was in a good condition, with enough benches and chairs for learners	1
Laboratory was very small and not neat, it was old.	1

The six observed practical lessons took place in laboratories which were old, dilapidated and as such not conducive for practical work. Of the five laboratories only one was conducive for practical work. It is important that the practical learning environment is conducive for learning if teachers and learners are to become interested in practical work. Teachers were further asked to state whether their schools had sufficient materials for conducting practicals in Biology. All 23 Biology teachers indicated that their schools did not have sufficient materials

for conducting practicals in Biology. According to Crawford (2000, p. 916), "increasing costs of equipments and consumables for laboratories have put science laboratories in universities and schools in a pathetic condition". The high cost of scientific equipment and infrastructure facilities required for science laboratories have resulted in several educational institutions being hesitant to put basic science subjects on their priority list (Crawford, 2000). This might also be the case in most of the Namibian schools as indicated by the teachers' responses. It was also observed that in all the nine practical lessons observed, there were not enough apparatus and equipment for all the learners to use. Learners shared the apparatus and equipment in three practical lessons observed. In the other two, the laboratory apparatus were for the teachers' use only, while in the remaining four practical lessons, there were no apparatus at all. For those schools that had apparatus, the researcher observed that most of the apparatus were in good working condition, a few were old and dusty indicating that they had not been used for a long time and some chemicals had long expired and thus could not be used during practicals.

The lack of essential laboratory resources tended to limit how much practical work could be done in secondary schools (Kandjeo-Marenga, 2008). Lack of resources can limit the number of practicals that can be carried out in Biology, in secondary schools. The researcher is of the view that the Ministry of Education and the Biology teachers should work together in order to ensure that there are enough practical resources at all secondary schools offering Biology. Improvising should be encouraged among Biology teachers in the conduct of practical work. Insufficiency of materials for conducting practicals, prevents teachers from allowing all their learners from doing the practicals themselves. In other words, teachers might be forced to do demonstrations only, instead of allowing their learners to do practicals on their own. Furthermore, this might also prevent teachers from carrying out all the practicals that were stipulated in the syllabus, which in turn might disadvantage the learners on the Alternative to Practical Work examination paper. To the question of whether the equipment was for teachers use only or enough to be used by the learners as well.

Ten (43%) of the teachers indicated that the equipment were for both teachers and learners while the remaining 13 teachers (57%) responded that there was only enough equipment for teachers to do practical work. If the schools do not have equipment for conducting practical work, for both the teachers and learners, teachers might be forced to do demonstrations only and might not allow learners to handle the equipment themselves. These findings are similar to those by Maboyi and Dekkers (2003) who found that almost all the Natural Science teachers in their study in South Africa preferred teacher demonstrations because of the lack of laboratories and laboratory equipment among others. On the question whether there were enough equipment for all learners to carry out practical work in Biology, all 23 teachers responded that the equipment was not enough for all the learners. All learners were supposed to be active participants during the practical lesson; they were supposed to be handling the apparatus themselves. If equipments are not enough for all learners, this might prevent some learners from participating during the practical lesson.

The Namibian Senior Secondary Certificate for Ordinary Level Biology Syllabus (Ministry of Education, 2009b, p. 27), states that, "learners should get practical (experimental and investigative) skills and abilities that will allow them to be able to follow a sequence of instructions; use appropriate techniques; handle apparatus/materials competently and have due regard for safety". Learners can only learn how to handle the apparatus or the materials if there are materials to be handled at their schools. If the apparatus are not enough, teachers might be forced to do demonstrations and learners will be forced to observe only. As such they might not be able to learn how to handle the apparatus when doing practicals. There is also a need for a different approach to timetabling in Secondary Schools such as where not everyone (teachers and learners) is in the laboratory at the same time, or a project based assisted learning where learners liaise with their teachers when they are available. The results in this section show that most secondary schools in the Oshana Educational Region did not have well stocked laboratories. Further, the laboratories did not have enough resources for conducting practicals.

Conclusion

This study found that not all the Biology teachers were doing practicals in Biology even though they said they did. The teachers did not allow their learners to do the practicals themselves even though they were expected to do practical work under the teachers' supervision. This might be one of the reasons why learners performed poorly on Paper 3. The study also found that both teachers and learners did not have Biology practical manuals to guide in the conduct of practicals. Without a practical guide for both the teachers and the learners, learners might not take practicals seriously and this might affect their performance on Paper 3. Furthermore, the study found that learners in some of the schools were not assessed at the end of the practical lessons, to determine whether they had understood the practical and to familiarise the learners with the questions format in Paper 3. This might have adverse impact on learners' performance on Paper 3.

Not all schools in the Oshana Educational Region had laboratories for conducting practical work in Biology. Some were too old while some did not have tables and chairs for learners. Without a laboratory for conducting practicals in Biology, teachers might not do practicals with their learners which will contribute to poor performance on Paper 3. Further, the secondary schools in the Oshana Education region did not have the necessary resources, apparatus and equipment for both the teachers and the learners to use during the Biology practical lessons.

Recommendations

In light of the findings of this study, the following recommendations are made:

Ministry of Education

There is a need for the Ministry of Education to budget for the building and equipping of Biology laboratories at secondary schools.

Advisory teachers

The Biology Advisory teachers should visit secondary schools regularly in order to identify the problems that teachers are facing in conducting practical work. In this way they will be able to assist Biology teachers in conducting practicals and in ordering required consumables and equipment.

Teacher training institutions

Teacher Training institutions should train teachers on how to conduct practical work in Biology.

Biology teachers

The Biology teachers should borrow materials from neighbouring schools for conducting practicals in Biology if they lack these at their schools.

Biology Teachers should inform the Biology Advisory Teachers where their schools do not have the necessary resources for conducting the practicals in Biology. In this way the Advisory Teachers might organise the needed resources for conducting practicals.

School management

School Management should organise bazaars, fundraising activities and any other money raising events in order to generate funds for buying equipment and chemicals that will help teachers to carry out practicals in Biology.

Suggestion for further research

A longitudinal study should be carried out that would shed more light on the nature of Biology practical work in Namibian secondary school classes. There is need to conduct a countrywide study that will shed more light on why Biology teachers are not conducting practical work at the secondary school level.

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