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Research Article

Teaching challenges in the senior phase natural sciences classroom in South African schools: a case study of Vhembe district in the Limpopo province

Ndivhuwo P Netshivhumbe[1], Awelani V Mudau* [2]

Department of Science and Technology Education, University of South Africa, South Africa.

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Abstract

This paper investigated some of the teaching challenges Senior Phase Natural Sciences teachers' experiences during their classroom practices in some of the rural schools positioned in the Vhembe District, Limpopo Province of South Africa. It was an interpretative qualitative study wherein two Senior Phase Natural Sciences teachers participated in the study. The data of the study was obtained through individual interviews with teachers as well as lesson observations. The findings show numerous challenges in the teaching of Natural Sciences including lack of required facilities and resources. Additionally, the study also reports challenges of lack of parental support, background of learners as well as language of teaching and learning. Consequently, this has impacts on teacher ability to implement Natural Sciences curriculum. Moreover, the findings also show that some of teachers available at schools used teaching experiences to teach Natural Sciences content and are reluctant to use various methods of instruction. Therefore it is suggested that the above mentioned challenges in Natural Sciences teaching need to be addressed so that what is taught and learnt through Natural Sciences curriculum at school can be meaningful to both teachers and learners in their everyday lives.

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Introduction

Qadeer, Tahir & Chishti (2018) reported that professional teachers have the capability in education, classroom management, cooperation with senior teachers and school principals, and have the freedom to create a democratic environment. There are numerous challenges encountered in the teaching of sciences at schools. Ali-Rweide (2019) reports barriers which affect doing experiments like school circumstances and lack of labs, crowded curriculum, large students' number in classes and danger of some experiments. Additionally, all of these barriers may affect the aims that science teachers try to satisfy from conducting experiments, and strategies used for that (Ali-Rweide, 2020). Science teachers are important in the teaching and learning of science at schools and thus there is no development of science education in the universe without teachers' contribution. From anecdotal evidence some science teachers available at schools are teaching different science subjects even though they specialised in one particular area at tertiary level. Teaching outside area of specialisation is a challenge which can results in an increase of teachers' lack of confidence and thus lead to teachers failure to enhance their ability to teach effectively. Additionally, teachers lack of confidence on a subject can be displayed in many ways, for instance when preparing and presenting lesson plan, selecting materials and activities to assist learners to learn, responding questions raised by learners as well as setting up laboratory for practical activities. Science concepts which are difficult for teachers to understand can be transferred

[1] PhD student, Department of Science and Technology Education, University of South Africa, P.O. Box 392, Pretoria, 0003 E-mail: ndivhuprudiey@gmail.com, Orcid no: 0000-0001-8266-4852
[2] Professor, Department of Science and Technology Education, University of South Africa, P.O. Box 392, Pretoria, 0003 E-mail: mudauav@unisa.ac.za, Orcid no: 0000-0002-0827-5688

towards learners incorrectly and create many alternative conceptions. Consequently well trained qualified teachers are required at schools in order to teach and assist learners to relate the ideas of science and address alternative conception. For this point of view researcher investigated challenges in the teaching of Natural Sciences (NS) at Senior Phase level of education.

Literature review

Availability of Well-trained Qualified Science Teachers

Teachers are expected to fulfil different roles these days not like in the past, where it was anticipated that the role of the teacher was to transmit certain information to passive learners and establish whether they were able to reproduce it, unchanged, in tests and examinations. Therefore, schools should have teachers who are qualified and dedicated in order to accomplish their roles as stipulated in the Norms and Standard for education including mediators of learning, interpreters and designers of learning programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors and learning area/phase specialists. Ngema (2016) shows that unqualified teachers or qualified teachers who do not understand the nature of science that has to be taught at school result in learners' poor performance. This means that there is a relationship between teacher content knowledge and performance of the learners at school. Budiastra, Wicaksono & Erlina (2020) state that teachers play a central role in the effective dispensation of the curriculum.

Teaching and learning of Natural Sciences (NS) can be effective if a well-trained qualified teacher is available at school to offer the subject. Budiastra, Wicaksono & Erlina (2020) indicated that teachers are supporting factors for a good education and quality of education cannot exceed the quality of a teacher. However, Budiastra, Erlina & Wicaksono (2019a) shows that there are still large numbers of unqualified teachers who teach science at schools. This means that lack of science teachers is a reality that exists in many schools. This result in under-qualified teachers to selects what they could teach and disregard what they could not due to lack of science background (Adeniran, 2020). Furthermore some under-qualified teachers fail to use the scientific equipment and they cannot do science practical investigations with learners because they are deficient in practical investigation skills (Adeniran, 2020).

Mudau (2013) defined teaching difficulty as a situation where teachers practices failure to create meaningful learning, resolve misconceptions, developing of inquiry as well as problem solving skills and thus influences learner academic performance. According to Du Plessis and Mestry (2019) some under-qualified science teachers only used textbooks to teach science and fail to do practical investigations with learners even if laboratories are readily available at their school to do practical activities. This means that teachers without appropriate knowledge of science might find it difficult to use various methods of instruction and resources available at school to assist in the implementation of science curriculum.

Alebous (2021) report that some of primary teachers hesitate to teach science because of limited subject matter knowledge (SMK) and pedagogical content knowledge (PCK) of science. Noble (2016) reported that primary schools teachers are teaching Natural Sciences though they lack confidence on the subject. Mudau and Nkopodi (2015) show that teachers who have science limited content knowledge (CK) lack confidence and find it difficult to teach science. Additionally, teachers who lack subject matter knowledge (SMK) may avoid teaching other science topics and such can results in learners not having a good foundation of science. Noble (2016) indicates that some teachers did made urgent pleas that they need to be assisted with curriculum delivery in their classrooms. Consequently teachers require subject matter knowledge (SMK) and pedagogical knowledge (PK) so that they can assist learners to receive proper education.

Budiastra, Wicaksono & Erlina indicated that (2020) categorise content knowledge (CK) that teachers should have into four types namely, Common Content Knowledge (CCK) which is a knowledge teacher have in order to teach including terminology, scientific notation and curriculum knowledge; Specialised Content Knowledge (SCK) is a kind of knowledge beyond what is required in the curriculum e.g. teachers must specialize in their subjects in order to explain content beyond the curriculum when arises; Knowledge of Content and Students (KCS) is a knowledge of content and of the learners abilities which assist teachers to assign task that are of learners interest and motivating as well as equivalent to learners cognitive abilities; and Knowledge of Content and Teaching (KCT) is a knowledge which teachers needs to understand the subject and pedagogical issues affecting them e.g. enable teacher to use correct instructional methods according to learners learning methods. The above statement is supported by by Budiastra, Wicaksono & Erlina indicated that (2020) where they reported that teachers who have the content knowledge (CK) are able to use various instructions and assign appropriate activities to their learners at school. Consequently it is imperative for subject teacher to be well-trained because the CK that the teachers have on a subject influences the

aspects of teaching including preparation, planning and the decisions made regarding the content to be taught and learnt.

Resources in the Teaching of Science

Adeniran (2020) report that teaching and learning of science is effective when required resources and facilities are readily available at schools. This means that sufficient textbooks and facilities such as classrooms, laboratories, and libraries are important aspects that lead to enhance effective science teaching and learning at schools. Moreover, textbooks are also important resources that give teachers comfort and convenience of having lessons planned out as well as gaining access to the appropriate knowledge and skills to teach at an appropriate level (Du Plessis and Mestry, 2019). Ngema (2016) indicates that the challenge of shortage of resources at schools is a matter of concern worldwide. Garcia and Weiss (2019) report that even though democracy dawned in 1994 in South Africa, there are still schools in the rural and township areas that lack resources and well-trained qualified sciences teachers. This means that some of the schools which are located in rural areas lack resources to be used to support teaching and learning, such as textbooks and laboratory equipment, which are compounded by a lack of infrastructures.

Adeniran (2020) states that shortage of resources including textbooks, physical infrastructure and laboratory equipment can hinder learners' interest in the subject and also resulted in learners' poor performance. Alebous (2021) reports that teacher find it difficult to teach science in a school that is not well resourced and also lack laboratories. Shortage of resources can also limit written work because teachers cannot give learners home activities as the learners do not have or they are sharing textbooks (Mupa and Chinooneka, 2015). Adeniran (2020) reported that learners had not been provided with sufficient textbooks and that some textbooks were of dubious quality. However, Alebous, (2021) indicates that teachers always mention lack of equipment, insufficient time and big classes as reasons for not conducting practical activities at their schools.

Du Plessis and Mestry (2019) states that limited resources encourage teachers to modify the curriculum by utilising hands-on experiences. Alebous, (2021) report that practical lessons clarify and reinforce scientific concepts. This means that availability of practical activities can develop learner interest and the love for science, improve learner cognitive skills and problem solving skills. Furthermore Juhji & Nuangchalerm (2020) indicated that it is importance for learners to conduct investigations and arrive at conclusions through observation. Alebous, (2021) emphasises the important of sufficient resources by reporting that observations and experimentation activities are essential in teaching and learning of science. Juhji & Nuangchalerm (2020) states that teachers with inadequate resources are encourage to source alternative resources in order to implement scientific investigation and develop problem solving skills to their learners.

Teaching Strategies of Science

According to Strouse, Nyhout & Ganea (2018) teaching and learning activities that involve students' active cognitive participation will create comprehensive teaching and learning. Therefore, the way in which a teacher presented a lesson to the learners determines it effectiveness and the level of understanding by the learners who are being taught. Teaching and learning of NS require both theoretical and practical knowledge. This means that NS promote learning that is active in the classrooms as well as outside the classroom, where learners can engage in authentic learning processes, such as cooperative learning, group work, practical work i.e. investigation, experiment etc. According to Budiastra, Wicaksono & Erlina indicated that (2020) teaching methods contribute to learner academic performance in the science subjects. NS curriculum expect learners to develop cognitive and practical skills such as experimenting, investigating, recording information, analysing and interpreting information as well as asking questions. Hence, it is teacher responsibility to develop and improve some of these skills to their learners during their teaching practices.

Adeniran (2020) reports that teaching methods used by some science teachers reduces science teaching to preparation for examinations and tests rather than enhancing the learner's abilities to explore ideas by means of hands-on activities. Adeniran (2020) further emphasized that science learning is still done by means of parrot learning which results in the subject being uninteresting. Additionally this can leads to failure of learners to relate new knowledge with their prior knowledge because they are likely to memorise concepts without understanding. However, the lecturing methods are used because of teachers being used to such method due to their teaching experiences (Lombaard, 2015). Mupa and Chinooneka (2015) argue that poor teaching methods have a direct influence on the poor performance of learners in the science subjects. Mupa and Chinooka (2015) where they indicates that teachers do not employ several teaching methods and they do not prepare a variety of media for use in the teaching and learning. Mupa and Chinooka (2015) further reported that teachers instructional materials are limited to textbooks and syllabuses and do not go beyond that. Budiastra, Wicaksono & Erlina indicated that (2020) point-out that the teacher is a profession that deals with the provision of education for nations' future generations; thus, teachers must

improve their competence as professional teachers. Therefore from time to time, attend refresher courses presented by different people so as to incorporate different methodologies.

Natural Science teaching that is learner centred can assist learners in developing knowledge and improve skills including identifying problems, doing investigations, interpreting information as well as communicating. Alebous, (2021) indicated that practical work in schools can effectively and strongly support exploration, manipulation and development of concepts and can make the concepts manifest, comprehensible and useful. This means that the methods and resources the teachers decide to employ should be related to the content to be taught so that learners can achieve the desire knowledge and skills. Alebous, (2021) suggested that science should be made practical so that the learners may relate it to their daily situations. Moreover, Alebous, (2021) also recommended that there must be regular seminars to equip the teachers with diverse methods of teaching.

Time Allocated for Natural Sciences teaching

NS is allocated three-hours per week and there are some teachers who are not using their time effectively. The study findings by Mupa and Chinooka (2015) indicated that a small percentage of teachers were on track, but that many teachers still failed to interpret the learning area policy and plan relevantly, which could make the ideal goals set by the Education Department futile. In addition, Mupa and Chinooka (2015) reported that pupils learn in harsh and conducive teaching and learning environments and there is low morale among teachers. Therefore it is very important for teachers to be prepared to actively teach for the minimum number of hours a day, every day as specified by policy.

Mbatha (2016), further reports that with the curriculum overload, teaching in most South African schools is moving too slowly to cover anywhere near the demands of the curriculum. Therefore, teachers needs to be careful when making selection of content, and make use of a variety of approaches to teaching and learning science as stipulated in Curriculum Assessment Policy Statement Natural Sciences Grades 7-9. The NS subject deals with the promotion of scientific literacy by developing and using science process skills in a variety of setting, application of scientific knowledge and understanding and appreciation of the relationship and responsibilities between science, society and the environment. Therefore, teachers must be able to create and design learning environments with atmosphere of prosperity and contributing to the learning targets (Darling-Hammond, Flook, Cook-Harvey, Barron, & Osher, 2019). Research also indicates that NS is so wide; there are many topics to be covered and a lot to do on each topic (Mtsi and Maphosa, 2016). Mtsi and Maphosa (2016) suggested that more time should be allocated for science teaching in the school curriculum to enable adequate coverage of all syllabus requirements including practical work in science. Consequently, teachers need to be punctual, well prepared and have the class ready, as simple starting points in time management.

The Language of Science Teaching

According to Ngema (2016) science requires people to understand concepts and being able to communicate them in writing. Mogashoa (2017) report that it is difficult for learners to understand and conceptualise content taught when they still struggle with the language used in teaching the subject. Nuangchalerm & El Islami (2018) states that science subject expect one to be able to analyse data presented in diagrams and communicate such data in words, and thus to know the theories and apply them. Hence, English which is the medium of instruction has been identified as one of the main barriers to learning science for the majority of South African learners (Prinsloo, Rogers and Harvey, 2018; Mogashoa, 2017). Ngema (2016) observe the problem is worsened if the science teachers are not proficient in English. This means that teacher who lacks proficiency in the medium of instruction results in the learners developing anxiety and a negative attitude towards people who speak the language; in this case it is the teachers. Furthermore, Hlabane (2014) indicates that language has a strong effect on educational quality, especially so in rural and historically black schools in South Africa, which have the problem of giving instructions in English and it affects greatly the quality of education. According to Sethusha (2015), English is used to teach curriculum subjects, which is not a home language in Limpopo Province. Hlabane (2014) state that it is important for the learners to understand English because they are expected to read the texts, analyse and come to conclusions. However, learners can be able to do such if they understand English.

Some science learners have difficulty in understanding the language of instruction which is English. Tshiredo (2013) report that proficiency in the medium of instruction results in good academic performance and Hlabane (2014) disagree with this finding by saying that science is a language on its own and a learner need to be proficient in both science terminology and English the medium of instruction in order to succeed academically. Sethusha (2015) indicates that some teachers sometimes use other official languages to explain certain abstract concepts when they teach, which is referred to as code switching; and teachers felt compelled to do this because learners are not proficient in English. However even if code switching is suggested to assist second language learners, there are also some words that cannot

be expressed which may lead to misinterpretation (Hlabane, 2014). Ngema (2016) suggested that science terms and English should be taught to learners so that they are able to express themselves and are able to analyse scientific information because there is no other way to teach it other than in English in order for them to succeed academically.

Parental Involvement in Science

Most of the teachers indicated that learners are not disciplined and some do not come to school whilst the support from parents is minimal (Mudau, 2013). Furthermore, learners lacked assistance with homework for example because the majority of parents are illiterate and thus not involved in supervision of learners beyond school environment (Sinyosi, 2015). Often the manifestations of non-involvement of parents in the education of the learner reveals among others negative factors of emotional distress, involvement of the child in violence and substance abuse for example (Du Plessis and Mestry, 2019). Ngema (2016) show that parents are unable to assists their children with school activities as well as additional resources because they are uneducated and unemployed. Most parents in the Du Plessis and Mestry (2019) study had attained only primary school level and thus resulted in a learner not receiving any assistance with their homework.

Poverty also played a major role. The majority of households where the learners came from were poor (Du Plessis and Mestry, 2019). The majority of the Learners' parents or guardians had their household income sources from primary informal agriculture which generated very little disposable income (Sahin, 2019). Parents serve as role models and guide in encouraging their children to pursue high educational goals and desires (Sahin, 2019). Du Plessis and Mestry, (2019) supported this assertion and indicated also that those learners whose parents are not adequately literate are disadvantaged because in modern education parents are required to assist children with their assignments and projects from the home. Some of these parents, although they had attained Grade 12 level of education could not assist the learners because they too lacked appropriate knowledge of the subject (Sinyosi, 2015). The study found that the majority of parents had attained educational levels less than Grade 12 income (Sinyosi, 2015).

Effective teaching and learning in school can only take place if the teacher, learner and parent involve themselves in the process, especially the parent, who is the main investor in the process (Sahin, 2019). Finding from a study conducted by Du Plessis and Mestry (2019) revealed that some parents are not able to assist their children with school activities and additional resources because they are uneducated and unemployed. These results in learners being unable to be not assisted by their parents nor can their parents afford tutors to assist their learners with extra lessons when they struggle (Ngema, 2016). Parents also do not participate actively in school matters. This limitation of parental involvement has a negative effect on a learner's education (Ngema, 2016). Consequently it is imperative for parents to be engaged in education of their children to improve children's performance.

Conceptual Framework

The study adopted classroom practices diagnostic framework (CPDF) by Mudau (2013) which theory offers an explanation on how teachers' knowledge and instructional strategies succeed interaction and discourse during teachers classroom practices. Teachers' knowledge and instructional strategies can be facilitated through teacher classroom practices. During classroom practices the teacher can display his/her knowledge of the curriculum understanding and learners preconceptions. The teacher can use his/her knowledge in determining instructional strategies to be used in a particular content of a lesson. The instructional strategies that the teachers decide on can result in interaction and discourse between the teacher and learners, between learners as well as between learners and the content taught. Therefore, teacher knowledge and instructional strategies are ideal for this study as they can promote interaction and discourse among the target group, i.e. teacher, learners. This takes place in the active learning environment. Moreover, challenges teachers experiences can be diagnosed appropriately in their classroom practices. Consequently, classroom practice diagnostic framework (figure 1) explored challenges teachers experiences in Natural Science classroom.

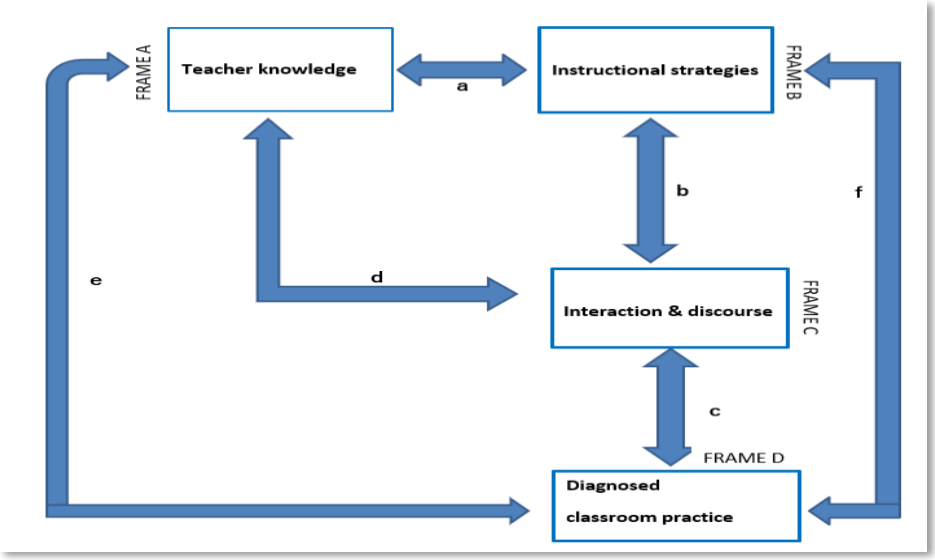


Figure 1.
Classroom Practice Diagnostic Framework (CPDF)

Problem of Research

The problem of this study was developed by one of researchers' anecdotal experiences. The hard work of the government of South Africa in producing qualified science teachers in rural areas such as in the Limpopo Province was noted. However, it was observed that there are still schools situated in rural areas with minimal or no teachers who specialise in Natural Science. It was evident that such teachers experience challenges when teaching the subject (Nkanyani, 2018). As a result, this paper explored some of the challenges teachers' experiences in the teaching and learning of Natural Science. The following research question guided the study, what are the teachers' view about the teaching and learning of natural sciences?

Method

Research Design

The main purpose of this paper was to explore the challenges teachers' experiences in the teaching of senior phase natural sciences at schools. For the purpose of this study, a qualitative research design was employed to provide rich descriptions of phenomena under exploration. Qualitative approach enable researcher to focus on actions performed, including reading and listening to words in all of their complexity as they occur in a natural setting or in a real context (Nieuwenhuis, 2016c). Qualitative case study was adopted as an educational style for this research. The study targeted Natural Science teachers from the Vhembe District, Limpopo province. This research used interpretative qualitative case study in an attempt to develop a full understanding on the challenges teachers' experiences when teaching Natural Science in the Senior Phase. The research sites for this study were rural schools under Makhado Local Municipality in the Vhembe District in Limpopo province. These sites were chosen for the study as they were public schools that offer Senior Phase Natural Science. The locality of Makhado Municipality can be seen on Figure 2.

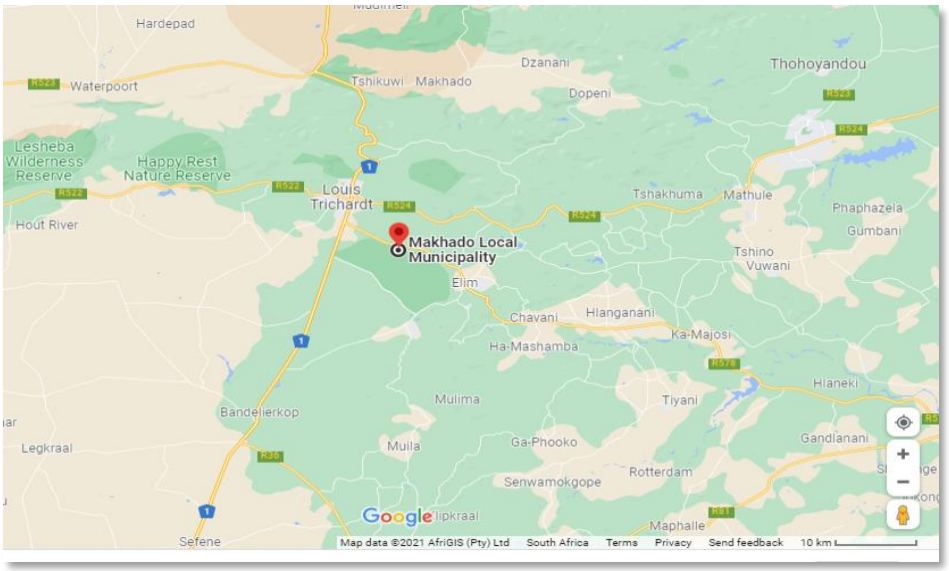


Figure 2.
Map Showing the Location of Makhado Local Municipality

Sample

The sample of the study consisted of two Natural Science teachers, i.e. two primary teachers and one secondary school teacher from the Vhembe District, Limpopo province. In this study, purposeful sampling was used because it enables the researcher not to spend more time gathering data from participants. In short, the researcher was favoured in terms of time. By using a purposeful sampling, the researcher managed to include two participants (cases) according to relevant criteria, i.e. teachers offering senior phase Natural Sciences at Vhembe District schools. Purposive sampling in qualitative research includes identifying and selecting participants that have experiences and knowledge about phenomena of interest (Annan, Adarkwah, Abaka-Yawson, Sarpong & Santiago, 2019). Hence, the selected teachers assisted the researcher in answering research questions and achieving the study aim. Therefore, it was not necessary to collect data from each rural public school in Vhembe District in order to acquire valid findings.

Participants

The total of two teachers participated in the study, one female and two males. The name of participants and schools used in this paper are pseudonyms and this was done to protect the identity of the participants. Two teachers were teaching senior phase at primary schools whereas one teacher was teaching senior phase at secondary school. Moreover, the teachers comprises of different qualifications and experiences. The table 1 below shows the demographic details of the two teachers:

Table 1.
Demographic Details of Teachers

Teacher and school pseudonyms	Gender	Qualification/s	Teaching experience in years	Number of years teaching natural science	Type of school
P1/J/F/SPS (Superiority primary school)	Female	Senior Teacher Diploma (Mathematics, Biology, English, Afrikaans)	16	13	Public school
P2/C/M/PSS (Presented secondary school)	Male	Higher Education Diploma (Mathematics, Chemistry and Physics)	18	15	Public school

Data Collection Tools

Observation

Observation is a systematic process of recording the behavioural patterns of participants, objects and occurrences without necessarily questioning or communicating with them (Budiastra, Wicaksono & Erlina, 2020). Observational tool was used to collect data during teacher classroom practices of natural sciences and the entire lesson was video-recorded to ensure accuracy of the data collected. Researcher obtained teachers' consent prior to lesson observation in order to ensure reliability and to avoid mistake of data collected during the process of analyzing data. The researcher

learns and observed participants in their classroom setting without taking part in any of the activities conducted in the lesson. The researcher transcribed the video-recorded lesson into the word document. Lesson observation supplied the researcher with information of what was actually happening in Natural Science classroom. However as far as teaching is concerned, only two lesson observations from each teacher was sufficient for the researcher to examine the challenges teachers experiences in NS classroom.

Interview

Data of this paper also obtained through the use of semi-structured interview. Semi-structured interview is a method used in qualitative research which researcher has an opportunity to prepare interview questions before conducting an interview with interviewees but ask open-ended questions which allow for discussions with the interviewee (Doyle, 2019). In this study, researcher conducted direct interview with the teachers where semi-structured interview form and audio-recorder was used in data collection. Interview tool was used to collect data based on teacher knowledge, instructional strategies as well as resources available to support teaching and learning at school. The audio recorder captured the data throughout the interview process and teachers asked the same open-ended questions.

Internal Validity

Internal validity is a way of making sure that the reader believes or is convinced by the findings of the research process (Korstjens & Moser, 2018). Pilot study was conducted with one senior phase natural sciences teacher who was not part of the main study where proposed instruments, i.e. observational tool and semi-structured interview tool was tested to ensure validity of this paper. Moreover, the researcher develop data analysis scheme (DAS) and implemented it in the pilot study. Additionally, the researcher increase study validity by focusing only on the data provided by the participants of the study.

Data Analysis

In this study, the two cases were analysed and interpreted separately. The researcher transcribed Video-recorded lesson and audio-recorded semi-structured interview of each case verbatim to word document. Thereafter, researcher replayed Video-recorded lesson and audio-recorded semi-structured interview of each case to verify if the words transcribed correspond with what was on the recording devices. However, grammatical errors displayed by participants were not corrected to ensure that the data gathered was presented accordingly and does not lose its meaning. McMillan and Schumacher (2014) report that inductive analysis is a process in which qualitative researchers synthesise and extract meaning from the data by deriving categories and patterns from specific data. Additionally, McMillan and Schumacher (2014) presented phases of qualitative data including(a) data organization; (b) data immersion; (c) generating categories and themes; (d) data coding; (e) offering interpretations through analytic memos; (f) searching for alternative understanding; and (g) writing of the report.

Results

The findings of this study obtained from the classroom practices of two cases. The cases were presented separately as this was not a comparative study. The study focus was to identify and understand some of the challenges each teacher experiences in natural sciences classroom practices. The researcher used codes to present cases of the participants:

Participant 1/P1/J/F/SPS/female/ Superiority primary school= ***P1/J/F/SPS***

Participant 2/P2/C/M/PSS/Male/ Presented secondary school = ***P2/C/M/PSS***

Themes proposed for study are as follows: Understanding teacher knowledge on content and context within Natural sciences curriculum, understanding teachers' instructional strategies within natural sciences curriculum

Case 1: Participant 1/P1/J/F/SPS/female/ Superiority Primary School= P1/J/F/SPS

Theme 1. Understanding Teacher Knowledge on Content and Context within Natural Sciences (NS) Curriculum

For the purpose of this paper, the researcher had to ask the teacher what she was going to teach and what learners' prior knowledge will be required in the learning of the content to be taught. During the interview process, the researcher noted that the teacher had an idea of what she was going to teach as she was able to give the lesson topic as well as the learners' prior knowledge needed in the topic to be taught. She indicated that she would teach about the separation of mixtures and such a topic falls under the knowledge strand of matter and material. During interview process she mentioned that:

***P1/J/F/SPS**: I'm going to teach separation of mixtures.*
***P1/J/F/SPS:** The prior knowledge that they must have it must be from their previous class grade 4, 5, 6 more especially in grade 6, then is where they have acquired the first knowledge that when we put 1 and 2 together they are now a mixture.*

During lesson observations researcher observed that the teacher did teach natural sciences, this was evident during lesson observation that took place in a classroom environment when she presented a lesson about separation of mixtures. During classroom practice, she taught about how to separate mixtures and methods of separating mixtures. When she taught about methods of separation mixtures she even demonstrated the methods. This was evident in the statement captured from classroom lesson observation below:

***P1/J/F/SPS:** You have put things together **(she put books together to make a mixture-see picture below),** what is to separate? I have made a mixture (Initiation, concept, Subject Matter Knowledge)*

mixture of books on Jane's hands

Learner: *taking things out and put them in their order (the teacher repeated the response)*
***P1/J/F/SPS:** My mother has boys and girls, we were using one rondavel being five at home, then my father build a 12 rooms house (learners whispering) then my mother try to separate us, how can she do that? (SMK, SI)*
***Learner 1 (L1):** my mother will take three boys to their room and two girls will share their room (response).*
***Learner 2 (L2):** each one of us get his or her own room (response).*

P1/J/F/SPS used different coloured chalks as visual aid to illustrate method of separation called hands sorting. See pictures below:

a) Coloured chalks

b) hand-sorting method

P1/J/F/SPS had maize meal, samp, beans and sieve as visual aid to illustrate method of separation called sieving. See picture below

a) Maize meal b) Samp c) beans d) sieve

***P1/J/F/SPS:** we want to see someone sieving, who can do that for us? (SI, demonstration, see picture below)*

Learner sieving

The researcher had to inquire further on learner socio-economic background and challenges that the teacher encountered in the teaching and learning of natural sciences. Based on the findings, learners have poor background as they depend on social grants. Teacher encountered numerous challenges in the teaching and learning of NS including insufficient resources, no laboratory, English instruction, insufficient time for teaching and learning, lack of parental support, lack of teachers as well as insufficient workshops. These challenges could result in learners not receiving proper education. During interview she indicated that:

P1/J/F/SPS: *Oh that one is challenging. Most of the parents depend on grants. Then you see that children do not have enough resources. For example others they come bare-footed at school, others you see that they are coming without eaten anything they are only waiting for the break that they will eat at school. And the other challenge is that most of the learners they stay with their grandparents at home who are illiterate. They are not being assisted; you gave them the task they come back without doing it. Why? Because there is no one who is behind them at home.*

P1/J/F/SPS: *You know we are at far, far, far rural areas. The challenges that we are facing is the language barrier and the second one is the resources. We don't have for example as you can see there is no laboratory here. The other thing is there are no laboratories to conduct the experiment, we don't have the apparatus here around us, and you have to search for ourselves and some materials that are useful we don't have. For example if I want a litmus paper where will I get it, even the school is failing to buy, the government failing to provide then that is the serious challenge that we are facing.*

P1/J/F/SPS*: Most of the concepts need more time to can cover. For example, the terminologies it need time because learners have to use dictionary. Can you see now we are going for a language, they have to use to check the word from the dictionary. They have to go for the key words, it takes time. Again we need to conduct experiment, it also need time. When you have a 30 minutes period you squeeze your lesson to be short, you shorten learners mind, because you can't give them everything at 30 minutes. Can you see, we cannot conduct a proper experiment with the proper result using little six hours per week*

P1/J/F/SPS*: Yes let me give. You know NS subject is too demanding, where it needs more workshops that can be conducted before, before the term. The problem that we are facing is that you find that the department is bringing the workshops at the middle of the term or at the end of the term. Now they have introduced the pace setters oh no not the pace setters I am referring to trackers, the planner and tracker they are bringing it very late when you have already pushed the content. Then I think we need more workshops. It also need team work, Natural Sciences need team work. Why? Because not all the strands are easily for the teacher to carry. If we can share the subject, then the problem is that we don't have enough teachers or enough educators at school, you find that such a person have to carry the whole of the subject.*

Theme 2. Understanding Teachers' Instructional Strategies within Natural Sciences Curriculum

The teachers play an important role in ensuring that learners understand the content taught in their learning environment. As a result, the researcher had to find out the instructional strategies used by a teacher during natural science lesson. The teacher revealed different methods she use when teaching Natural sciences. This was supported by statement from interview below:

P1/J/F/SPS*: I use different methods. When we teach Natural Sciences we use demonstrations, we use a…it might be interview, we also use this one that we are doing now, we interview to check learners, question and answer method, identifying, illustration, discussion, group work these are the methods that we use.*

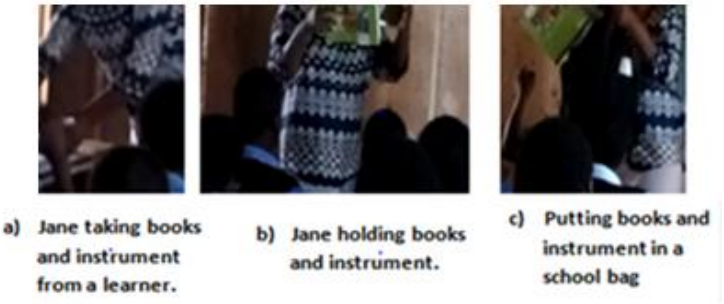
During the lesson observation process, researcher noted that teaching strategies the teacher used includes, question and answer, lecturing, demonstration; illustration, modelling. Additionally, learners were given class work and homework. Learners were asked to explain the mixture and give examples of mixtures. Most of the learners raise their hands as an indication of being able to recall what they learnt in the previous grade. The learners gave the correct answers. This was supported by statements from lesson observation below:

P1/J/F/SPS: *What can you say when you define a mixture?*
Learner 1 (L1): *is objects that are mixed together.*
P1/J/F/SPS: *can you give me the examples, what is it that you can mix together?*
Learner 2 (L2): *sugar and water*
Learner 3 (L3): *cement and sand*

P1/J/F/SPS used the lecture method to explain what a mixture is and how the substances are put together to form a mixture in order to make learners understand the concepts. P1/J/F/SPS also used both the lecture and demonstration methods when explaining how substances are put together to form a mixture In addition, she makes use of the demonstration method using examples for learners to gain a better understanding of the concept.

P1/J/F/SPS: *a mixture is when two or more substances are put together. When we say two or more substance is put together we find these substances are put together in a physical way. The way that you can see, and the way that you can see physically* (lecture method used to make learners understand the concepts).

P1/J/F/SPS: *you see someone taking an instrument and the books putting inside the school bag that is a mixture* (example-demonstration methods. See pictures below (a-c)



During interview P1/J/F/SPS indicated that she used modelling when showing substances to be mixed to form a mixture and she used illustration with examples from the textbook. She also uses examples when explaining separation of mixtures.

P1/J/F/SPS: *I use modelling, under modelling I was showing the substances that we are going to mix and then after they have been put together which is a mixture.*

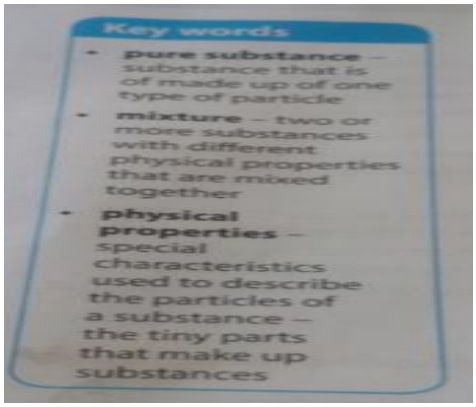
P1/J/F/SPS had rice, beans and salt as visual aid to demonstrate a mixture. See pictures below

P1/J/F/SPS formed a mixture by means of putting rice, salt and beans together and she gave the learners an opportunity to separate the mixture.

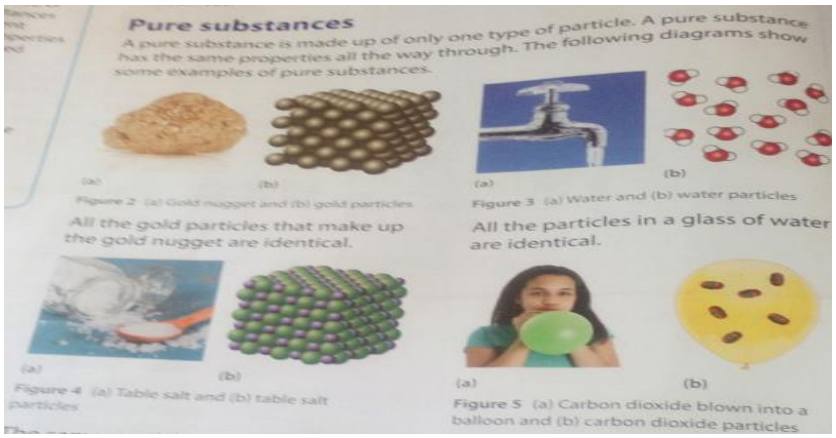
a)mixture

b) learners separating the mixture

The study also revealed that the teacher make use ***illustration with examples written from platinum NS textbook to teach the content to the learners.*** Learners were told to open page 80 on their platinum grade 7 Natural Sciences textbook. Thereafter she asked learners questions. See pictures A and B below.



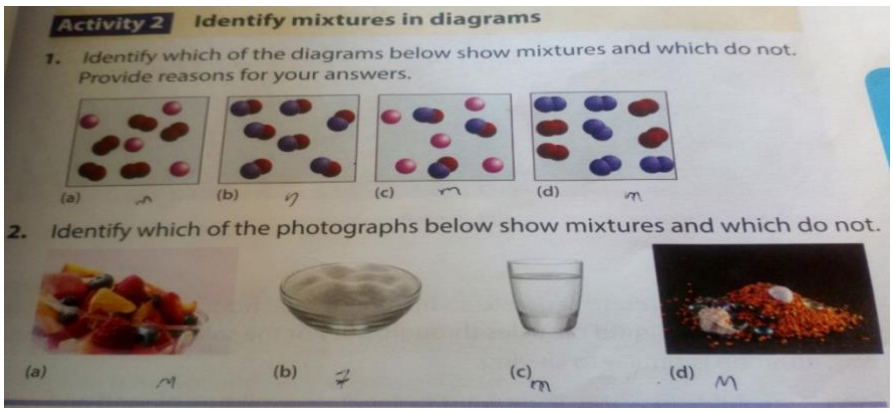
A) Key words

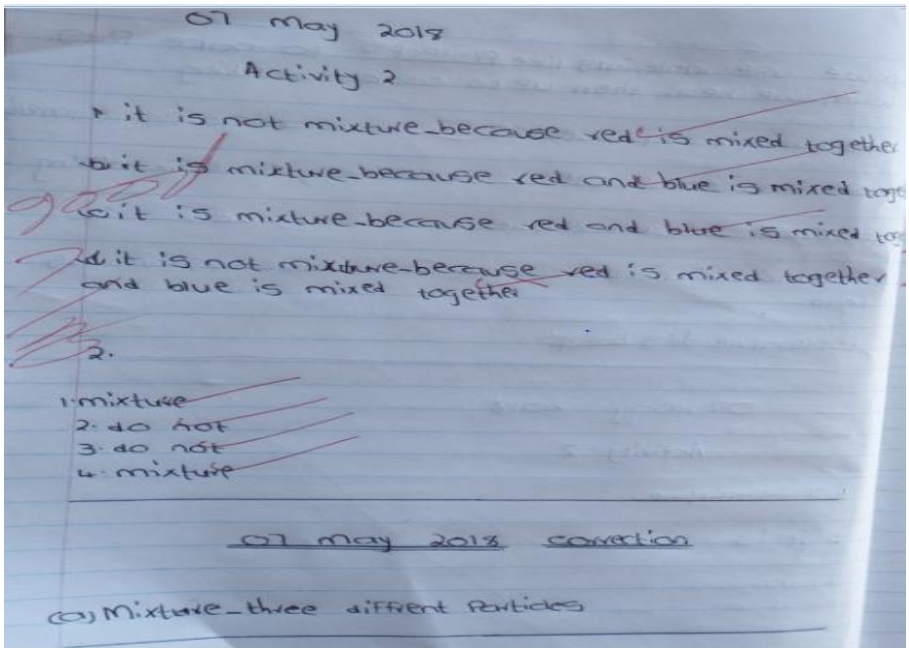


B) Examples of pure substances

P1/J/F/SPS: *there are key words there, number 1 what is written there* (picture A above)? (Initiation, authoritative)
Learner 1 (L1): pure substance (response)
P1/J/F/SPS: *what does it mean?*
Learner 2 (L2): *substance that is made up of one type of particle.*
P1/J/F/SPS: can you give me the example of a substance that is made of one particle (SI)
Learner 3 (L3): water (response)
Learner 4 (L4): milk (PK, not shown on picture B above)
Learner 5 (L5): salt (response)
P1/J/F/SPS: No, no, salt there are some particles there (Authoritative-convey information)
Learner 6 (L6): gold (response)
P1/J/F/SPS: *can you point where you find it?* (Learners pointed at their textbook picture B above)
Learner: *gold particles* (response)
P1/J/F/SPS: *Water particles, where are water particles?* (Learners pointed at their textbooks, see picture B above)

During the lesson it was noted that learners wrote and marked the classwork. The two pictures below show classwork given to learn and the marked classwork.





Case 2: ***Participant 2/P2/C/M/PSS/Male/ Presented secondary school = P2/C/M/PSS***

Theme 1. Understanding Teacher Knowledge on Content and Context within Natural Sciences Curriculum
During the interview process, the researcher asked the teacher what he was going to teach and the resources he intend to use. He indicated states of matter and the arrangement of particles as his lesson topic which fall under the knowledge strand of matter and materials. He further indicated chalkboard and textbook as his resources for the lesson.

Researcher (R)*: What are you going to teach today?*
P2/C/M/PSS*: State of matter and arrangement of particles*

The teacher displayed adequate content knowledge when he explained three states of matter in terms of their arrangement, movement, and spacing using the particle model of matter. This is evident in the statement stated during lesson observation below:

P2/C/M/PSS*: The arrangement of particles of solid, liquid and gas. The arrangement of particles solid or ice are arrange in specific pattern. Liquid are loosely arranged and are not in a fixed shape. Gas or steam they are not arranged in a specific pattern. Movement of particles; under ice they vibrate in a fixed position, water they move more freely than in solid and slide pass each other, and steam move randomly in all the direction and fill the whole container the space between the particles particles of ice are closely paired. The space between water is large and space between steam are very large.*

The researcher had to inquire further on the challenges the teacher encountered when teaching natural science. Based on study findings, the teacher encountered numerous challenges including insufficient teaching materials as he indicated that only textbook and chalkboard are materials available to support his teaching. He further indicated that he attended workshops where he attain knowledge he did not know which was a challenge to him. It was noted that

the teacher sometimes responded interviews questions using his home language which is Tshivenda. During interview process he stated that:

***P2/C/M/PSS**: Ndi ya ndi tshi athenda dzi workshop dza science ndi hone hune ndavha ndi khou tangana na zwithu zwiswa zwine nda sa zwi divhe zwine kha nne zwavha zwi challenge. Kha workshop ri vha ri khou ainiwa zwithu zwine ri si zwi divhe*

The teacher pointed out that learners were coming from poor background and they are depending on social grants. The other challenges teacher stated was that learners understanding have been delay as there were no experiments for lesson demonstration. This is evident in the statement from the interview below:

***R:** Which factor do you think delays learner understanding?*
***P2/C/M/PSS:** Ndi ngauri a hu na zwi experiment zwa u demonstrator lesson heyi.*

The teacher indicated that the time allocated for natural sciences teaching and learning was not sufficient as it requires learners to conduct experiment, investigation and project which requires more time. This was evident in the statement from interview below:

***R:** Do you think the time allocated for Natural Sciences teaching is sufficient to complete or cover the intended curriculum?*
***P2/C/M/PSS:** No.*
***R:** Why are you saying no?*
***P2/C/M/PSS:** Ndi ngauri science I toda tshifhinga tshilapfu ngauri huvha hu na zwi experiment, investigation na dzi projects lune zwi toda u na tshifhinga tshilapfu. Ri lilela u tavhanya u fhedza syllabus ngeno vhana vha khou salela murahu.*

Theme 2. Understanding Teachers' Instructional Strategies within Natural Sciences Curriculum

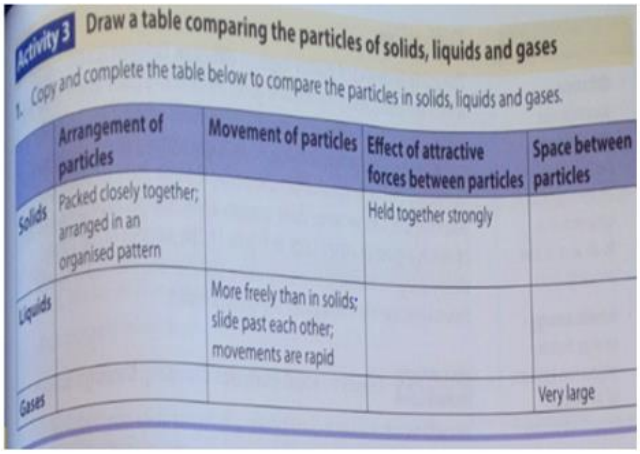
The researcher had to find out more on the instructional strategies that the teacher used in the teaching and learning of natural sciences curriculum. It was noted that the teacher used questioning strategy that requires learners' prior knowledge at the beginning of the lesson. Examples of questions that the teacher initiated in order to engage and evaluate learners at the beginning of the lesson are as follows:

P2/C/M/PSS: what is matter?
Learner: *model that helps us understand that matter is made from particles and how they affect the behaviour of matter (misconception).*
Learner: *matter is that occupies space and has mass.*
***P2/C/M/PSS**: matter is anything that occupies space and has mass. Mention three state of matter.*
Learner 1 (L1): *solid.*
Learner 2 (L2): *liquid*
Learner 3 (L3): *gas*

P2/C/M/PSS *used Tshivenda to explain sublimation process using example. He indicated that:*

***P2/C/M/PSS**: When ice turns to gas which is vapour it is called sublimation. Naya checkers hangei ho no rengiswa dzi khovhe ni do wana murahurahu hangei khovhe dzedzi dzi nobva madini ni wana dzo vhewa kha inwe ice mara nga ngomu ni tshi sedza a ninga do vhuya na wana huna madi kha hedzila ice, ri khou wanana ne ni do wana hu khou sokou bva vhunwe vhutsi so hu khou vha na evaporation ri khou wanana ne and learners said yes. heyo dry ice a i turn ubva kha ice ya ita water, I turner ubva kha ice yavha vapour.ndi hafho i no vhudziwa upfi sublimation*

The teacher gave learners class activity which was from platinum grade 8 Natural science, see picture below:



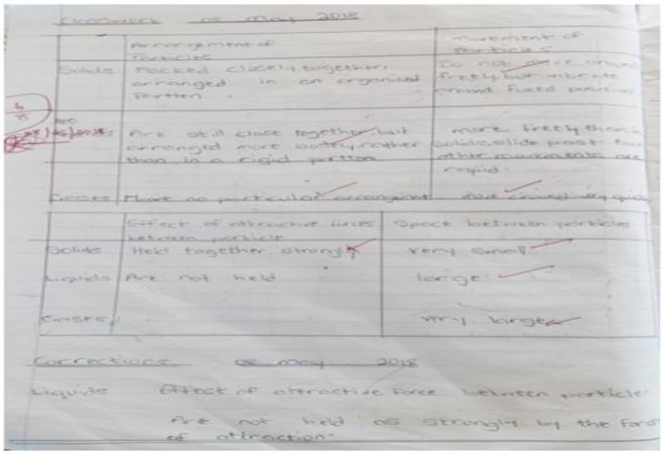
Activity 3 Draw a table comparing the particles of solids, liquids and gases

1. Copy and complete the table below to compare the particles in solids, liquids and gases.

	Arrangement of particles	Movement of particles	Effect of attractive forces between particles	Space between particles
Solids	Packed closely together; arranged in an organised pattern		Held together strongly	
Liquids		More freely than in solids; slide past each other; movements are rapid		
Gases				Very large

.

The picture below shows class activity marked:



Discussion

The study conducted by Budiastra, Erlina & Wicaksono (2019a) reported that there are still large numbers of unqualified teachers who teach science at schools. The above statement is supported by the study findings which revealed that teachers participated in the study acquire different teaching qualifications and none of them majored in Natural Science (NS). **P1/J/F/SPS** holds a teaching qualification of Senior Primary Teacher Diploma where she specialised in Mathematics, Biology, English, Afrikaans and Bed Hons.in management. **P2/C/M/PSS** holds a qualification of Higher education diploma majoring in physical sciences and mathematics. This means that lack of science teachers is a reality that exists in many schools. The study found that insufficient resources and unavailability of laboratories are the main challenges that NS teachers experienced during their teaching practices. **P1/J/F/SPS** indicated that school lack resources and no laboratory for conducting experiment as well as apparatus. This is similar to **P2/C/M/PSS** as he mentioned that only textbook textbooks and chalkboard are available to support teaching and learning. According to Alebous (2021) teachers always mention lack of equipment, insufficient time and big classes as reasons for not conducting practical activities at their schools. However, Juhji & Nuangchalerm (2020) indicated that it is importance for learners to conduct investigations and arrive at conclusions through observation. The above statement is supported by the findings of this study, even though the schools have insufficient resources **P1/J/F/SPS** improvise materials that assisted learners to understand the content taught without difficulties. Additionally, besides the textbook **P1/J/F/SPS** provided at her school she also prepared other teaching aids to assist learners to learn and understand the concepts better. Alebous (2021) emphasises the important of sufficient resources by reporting that observations and experimentation activities are essential in teaching and learning of science. This means that laboratories and necessary equipment to carry out practical activities must be readily available at schools.

The study find that learners are from poor family background and that negatively affected the teaching and learning of science. The data obtained revealed that most learners depend on social grants and some learners go to school without shoes and empty stomach. Therefore such situation negatively affected learning as learners cannot participate fully with empty stomach. The above statement is supported by **P1/J/F/SPS** as she indicated that most of the learners

depend on social grants and they are not well resourced. **P2/C/M/PSS** reported background of learners was poor as they depend on grants. The study also revealed that teachers are using their teaching experiences to teach Natural Science because of shortage of teachers at their school. The study further indicated that English as medium of instruction has an impacts in teaching and learning of science. **P1/J/F/SPS** point out that learners are not fluent in English and they find it difficult to learn the concepts, which results in the teacher being slower when teaching so that all learners can be accommodated. Research by Mogashoa (2017) indicates that it is difficult for learners to understand and conceptualise content taught when they still struggle with the language used in teaching the subject. Additionally Ngema (2016) observe the problem is worsened if the science teachers are not proficient in English. Participants of the study also revealed that time allocated for teaching and learning of science is not enough to cover the content to be taught. **P1/J/F/SP** indicated that the time for teaching and learning natural sciences was Insufficient which results in other content not being covered. **P2/C/M/PSS** mentioned that the time allocated for natural sciences was not enough because there are activities like experiments, investigations and projects that need to be done and such activities require more time. It is clear from the above statement that science teachers have a big load of work to do science by its nature requires a lot of time because teachers have to also give extra lessons to learners as there is little time allocated for this subject and they also have to prepare for practical investigations.

Another finding highlighted by the study is that parents are unable to support their children with additional resources as well as their school work because they are illiterate and depend on social grants. **P1/J/F/SP** indicated that most of the parents are illiterate which results in learners not being assisted with their schoolwork. This finding is consistent with results of researchers like Ngema (2016); Chinyoka & Naidu (2014) which show that some parents are not able to assist their children with school activities and additional resources because they are uneducated and unemployed. The finding of the study also revealed that the workshop conducted is not sufficient since it is once per term. **P1/J/F/SP** pointed out that natural science is too demanding and it requires more workshops.

Conclusion and Recommendations

The purpose of this study was to examine challenges in the teaching and learning of senior phase natural science. Even though this is not a comparative study, one can infer from the results and discussions herein that teachers under study for this paper mainly face challenges which are almost the same. Some of the challenges in the teaching and learning of science including lack of facilities and resources are so fundamental that lead to a failure to enhance effective teaching and learning at school.

The findings of this study provide evidence that there are multiplicity of challenges in the teaching and learning of NS and the following is recommended:

- Basic infrastructure and appropriate resources such as teaching material and lab equipment should be made available in rural schools in order for teaching and learning to be effective.
- Qualified and well trained science teachers must be available in rural schools.
- NS should be allocated more time so that teachers can be able to cover the required syllabus including hand on activities.
- Subject advisors should see that more than one workshop conducted per term to improve teachers' classroom practices.
- The departmental meetings at schools should be taken into consideration as it can assist both HOD's and subject teachers to share ideas on the NS subject, resolve NS contemporary issues and seek assistance where necessary.
- NS teachers should work as a team in order to assist each other to make NS teaching and learning more effective.
- Parents and teachers should work together to improve learners education.

Limitations of the Study

The study focused on two Natural Sciences teachers from Vhembe District in the Limpopo Province. One teacher was teaching grade 7, and the other teacher was teaching grade 8. The fact that the study only focused on two teachers in the Vhembe district may be viewed as a limitation of the study, however through the rich description provided during analysis of data the finding may be applicable to other districts with similar contexts.

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Biodata of the Authors

Miss Ndivhuwo Prudence Netshivhumbe is a PhD student of Science Education at the University of South Africa. She was born in Limpopo, South Africa, February 15 in 1989. She holds MEd (Science Education) from the University of South Africa. She teaches Physical Science in The Limpopo Province of South Africa **Affiliation:** University Of South Africa **E-mail:** ndivhuprudiey@gmail.com **Orcid number:** 0000-0001-8266-4852 **Phone:** (+27) 79 588 1662

Prof. Dr. Awelani V Mudau, D.Ed., born in Johannesburg, South Africa, June 12. He obtained a Diploma in Secondary Teaching in 1996, Further Diploma in Education in 2004, Bachelors of Science with Honors degree in Science Education in 2006, Masters of Science in Science Education in 2008, and a Doctor in Education in 2013 from Tshwane University of Technology. He is a full Professor in the Department of Science and Technology Education at the University of South Africa. **Affiliation:** University of South Africa **E-mail**: mudauav@unisa.ac.za **Orcid number:** 0000-0002-0827-5688 **Phone:** (+27) 12 429 6353

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