International Journal of Educational Review, Law & Social Sciences (IJERLAS)
International Journal of Educational Review, Law And Social Sciences (IJERLAS Journal) | ISSN(e): 2808-487X
Volumes 5 No. 2 (2025)

EXPLORİNG SUBJECT MATTER KNOWLEDGE OF SOME TEACHERS İN THE SENİOR PHASE NATURAL SCİENCE CLASSROOM

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Received	: 15 January 2025	Published	: 17 March 2025
Revised	: 30 January 2025	DOI	: https://doi.org/10.54443/ijerlas.v5i2.2379
Accepted	: 15 February 2025	Publish Link	: https://radjapublika.com/index.php/IJERLAS

Abstract

The purpose of this interpretative qualitative study was to examine the subject matter knowledge of senior phase natural science teachers in some of the schools positioned in the Vhembe district of the Limpopo province. A Classroom Practice Diagnostic Framework has been used as a theoretical framework for this study. Classroom observations and interviews were used to collect data from natural science teachers. The results of the study show that teachers have subject matter knowledge as they were able to teach natural science subject to their learners, clarify misconceptions and learners were able to relate what they are taught in natural science with their environment. However, the teachers did not specialised with natural sciences in their teaching qualifications. Furthermore, teachers employed different methods such as questioning, demonstrations, examples and discussions which encouraged and motivated learners to actively participate in their learning. The findings also revealed that teachers used different materials to support their classroom practices and to assist learners in understanding the concepts taught. It is recommended that teachers should be encouraged to attend subject matter knowledge continuous development programmes to enhance their knowledge in all subjects they teach for learners to have a good foundation and interest on their school subjects.

Keywords: ***Knowledge, teachers, classroom, natural science, Senior Phase***

INTRODUCTION

In most of south African schools, teachers are teaching subject that are not qualified to teach due to shortage of teachers to offer a particular subject. It is very important for teachers to teach the subject they are qualified to teach in order to lay a good foundation on a particular subject to their learners. So it is important for each curriculum subject to be offered by a subject matter expertise. In this study, subject-matter expertise referred to a person who has specialized in a subject he or she is teaching. Therefore this person has a specialized knowledge and experience in a specific subject. A qualified teacher on a particular subject has knowledge of the subject in and outside the classroom (Murtaza, Zubair & Saima, 2023). Additionally, this person can relate what is taught in the classroom and the world they are living on. Teachers who have subject matter knowledge know what they need to teach and how inorder for the learners to understand the ideas of the lessons. According to Jadama (2014) understanding of subject matter by a teacher implies that teachers are able to teach the main points of the subject matter to learners. Furthermore, Jadama (2014) indicated that a teacher that is knowledgeable in the subject he or she offered at schools, he or she should be able to explain the subject concepts without difficulties to his or her learners.

Mudau and Netshivhumbe (2021) indicated that 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. They further reported that such has impacts on teacher ability to implement Natural Sciences curriculum (Mudau and Netshivhumbe, 2021). Therefore, for teaching to be more effective, teachers need to be able to deliver content, instructing information on a subject and have current knowledge on the subject. Understanding enables them to use different teaching methodologies to help students learn subject matter, usage of different methodologies impact on teaching and learning (Jadama, 2014). Teachers are expected to impart knowledge and facilitate learning in such a way that will expand learners understanding and engagement in a specific area during their learning process. There are some school positioned in rural areas that lack teachers who are teaching subject they are qualified to teach. According to my teaching experience in rural schools, some of teachers are offering subjects they did not

study during their teaching qualification because of shortage of teachers in their school. The researchers hope that the findings of this study could assist teachers in shaping subject matter knowledge in their classroom practices as well as assisting departmental officials in organising sufficient workshops to support teachers on the subject they are offering at schools. In this study, subject matter knowledge of some senior phase natural science teachers was explored**.** The study showed the impact of teachers' subject matter knowledge on learners academic performance. The main goal was to examine teacher subject matter knowledge and its influence towards learners' academic performance. The research question explored was "What is the nature of teachers subject matter knowledge in the teaching of senior phase natural science?"

LITERATURE REVIEW

Subject matter knowledge in the teaching and learning environment

The teachers are expected to have knowledge on the subject they are instructing. The knowledge of the teacher should comprised of content knowledge, pedagogical knowledge and knowledge of learners' understanding (Shulman, 2021). The teachers' understanding knowledge deals with the knowledge of learners prior knowledge, linguistic abilities, and learners interests as well as their misconceptions (Mudau 2016). This means that for teachers to have appropriate subject matter knowledge they need to study the subject they wish to teach in their teaching qualification. Netshivhumbe (2018) indicated teachers with pedagogical knowledge will find it easier to fulfil their daily task in their classroom which is teaching learners

Natural science subject

According to Curriculum Assessment Policy Statements (CAPS) Grades 7 – 9 Natural Sciences (Department of Basic Education, 2011), science is a systematic way of looking for the explanations of the ideas and connect such ideas. This means that the knowledge that learners get in the natural science classroom should allow them to used discovery skills by means of searching for various explanation on a particular idea and look for the connectivity. Natural science curriculum comprised of four knowledge strands, namely Life and Living, Matter and Materials, Energy and Change, Planet Earth and Beyond and these strands are used to organise natural science content (Department of Basic Education, 2011). Therefore, it is essential for natural sciences teachers to assist their learners to relate what they are learning in their classroom with their environment. Teacher need to used learners prior knowledge and connect such knowledge with the new information related to the topics inorder for learners to learn and gain a better understanding of natural science.

Teacher need to assist learners in developing thinking skills for them to be able to see the connectivity of natural sciences in the intermediate phase and senior phase Natural science. Natural science offer learners an opportunity to make sense about the environment using the information obtained during their natural science classroom. Hence, natural science encourage learners to ask questions that may lead to further research and investigation (Department of Basic Education, 2011). Natural science consists of three specific aims i.e.,the doing of science, knowing the content and make connections, and understanding of the uses of sciences (Department of Basic Education, 2011). The first specific aim of doing science required learners to learn through doing where learners can perform experiments and do investigations. The second specific aim of knowing the content and make connections, this required learners learn the ideas of natural sciences and able to make connections among those ideas. Therefore, the second and third specific aim raise concern to teachers as they are the one who need to see that learners are learning appropriate content in such way that they are able to understand and make connection on a particular topic learnt from different grades.

Natural science comprised of several skills that learners need to master and such skills teachers need to assist learners to develop them so that they can be able to employ them where applicable. This means learners should be assisted in such a way that they will know when to used such skills. Department of Basic Education (2011) indicated that learners can develop and improve cognitive and practical skills such as experimenting, investigating, recording information, analysing and interpreting information as well as asking questions during natural lessons. This means the natural science encourages learners to think on their own and come up with relevant information on specific ideas.

Availability of Natural science teachers

Teaching and learning of Natural Sciences can be effective if a well-trained qualified teacher is available at school to offer the subject (Mudau and Netshivhumbe, 2021). Natural science teaching can be effective if specialised teachers are available in schools to offer the subject. Budiastra, Erlina & Wicaksono (2019a) shows that there are

still large numbers of unqualified teachers who teach science at schools. In some schools, teachers are teaching subjects which they are not qualified to teach because of shortage of teachers. This result in under-qualified teachers to selects what they could teach and disregard what they could not due to lack of science background (Nkanyani, 2018). Teachers who lack subject matter knowledge may avoid teaching other science topics and such can results in learners not having a good foundation of science (Mudau and Netshivhumbe, 2021). 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).

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 (Mudau and Netshivhumbe, 2021). Additionally, this might cause the teacher to become uncomfortable because it is not easy to teach what you do not understand. Some teachers hesitate to teach science subject because of the limited knowledge they have on the subject. The teachers who have sufficient knowledge on the subject are able to employ various methods during their classroom practices depending on the subject content. Therefore, it is very imperative for the Department of Education to employ subject expert because the knowledge that the teachers have on a subject influences the aspects of teaching such as preparation, planning and the decisions made regarding the content to be taught.

Theoretical framework

In this study, The Classroom Practice Diagnostic Framework by Mudau (2016) was adopted because one of the component of this framework focus on teacher knowledge which is the aspect that this study explored. This study developed framework after borrowing some aspects of teacher knowledge from Classroom Practice Diagnostic Framework developed by Mudau (2016). Using Classroom Practice Diagnostic Framework, the researcher identified the impacts of subject matter knowledge in the teaching and learning of natural science in the classroom. As displayed in

Figure 1, the classroom setting is important as it is where the participant of the study was found. Therefore, teacher subject matter knowledge is very important in the classsroom because it has an impact on learners learning. This knowledge influences every action in the teaching and learning environment. Therefore, researcher examined three categories in subject matter knowledge i.e., Content, context and learners understanding. The researcher discovered the impact of these three categories within the subject under exploration. Therefore, it is crucial for subject teachers to re-evaluate how effective their subject matter knowledge during their classroom practices influenced learners' participations and their academic performance.

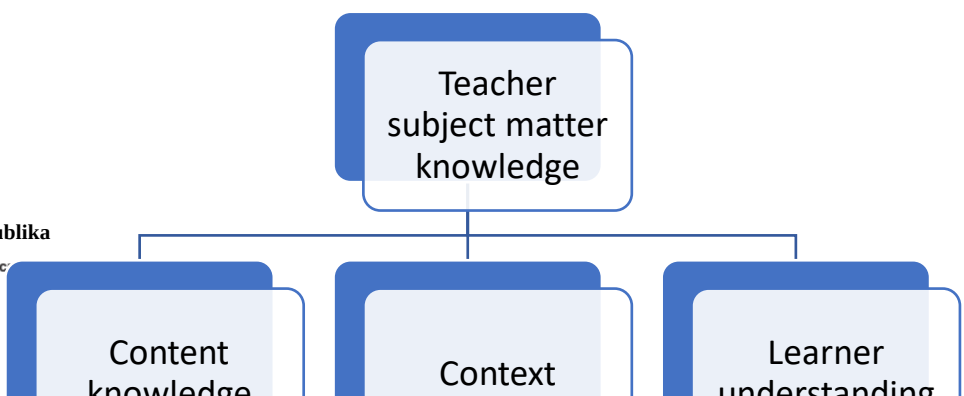

Figure 1:Teacher subject matter knowledge framework

METHODOLOGY

Research Design

The purpose of this paper was to explore the subject matter knowledge of some teacher in the teaching and learning of senior phase natural sciences at schools. The study employed qualitative case study approach which allowed the researcher to understand the phenomena under exploration. According to Nieuwenhuis (2016), qualitative approach allowed academics to focused on actions performed such as reading and listening to words in all of their complexity when occurred in a natural setting or in a real context. The study was conducted at rural schools of Vhuronga 2 under Vuwani cluster in the Vhembe district. These schools was chosen because they are located in a rural area where the researcher stays and there is a lack of facilities such as laboratory. The researcher employed case study approach as a research mechanism to serve the patent need to develop a full understanding on the subject matter knowledge of natural science teachers from schools positioned in the Vhembe District. Therefore, qualitative case study approach was imperative for this study as it allowed the researcher to examine subject matter knowledge of natural science teachers during their classroom practices.

Participants sampling

For this study determination, a purposeful sampling of two senior phase natural science teachers in each of the two selected schools from Vhuronga 2, Vuwani cluster participated in the study. The participant was one female and one male and the names appearing in this paper are pseudonyms which was done in order to protect the identity of the participants. Both teachers had a teaching experience in natural science subject and they comprised of different teaching qualifications.

Data Collection Tools

Semi-structured interview and classroom observation were used for data collections. The two teachers were interviewed and observed at their school setting. Also, recording devices i.e., audio and videos was used during data collections. Audio was used during intervies and videos was used during classroom observations. These devices assisted the researcher when analysing data of the study. Thefore, interviews with teachers was conducted before and after the lessons. The two lessons were observed from each teacher.

Data Analysis

The data obtained from two cases and the cases were analysed and interpreted separately. The videos and audios recorded were transcribed into a word document by the researcher. After, transcriptions of both interviews and observation from recording devices to word document, the recorded data were replayed in order to verify if the words transcribed corresponded with what was on the videos and audio-taped. Thereafter, the transcribed data was showed to relevant participant before the researcher considered such data as final product and all grammatical errors participants presented was not corrected to ensure that the data collected does not lose its meaning. The data obtained were presented in cases i.e., case 1 and case 2. Subject matter knowledge was utilised to analyse data collected for the study. Therefore, only the data related to theme subject matter knowledge obtained from two cases was included in this study.

RESULTS

The results of this study were obtained from the classroom observation and interviews of the two cases. The data presented in this section only focuses on categories and characteristics of the theme of teacher subject matter knowledge which was investigated in order to know and understand the impact of teacher subject matter knowledge in a senior phase Natural Science classroom.

Impact of teacher subject matter knowledge

Case one: Jane

Content

Jane lessons focused on mixtures, classification of mixtures and methods of separations which fall under natural sciences knowledge strand of matter and materials. Jane subject matter knowledge was develop through natural science workshops conducted by the department and her teaching experiences. Jane majored with mathematics and biology on her teaching qualification. The subject matter knowledge that Jane presented was appropriate and organise. At the beginning of each lesson, she introduced the topic of the lesson and thereafter asked questions based on the topic.

By so doing she was able to get learners attention and they participated by answering questions using their prior knowledge and the new knowledge provided by their teacher. Additionally, she was able diagnosed what learners recall about the topic. Jane sees the important of linking the previously knowledge with the new knowledge of the topic. Jane knowledge on subject matter was appropriate as she was abled to asked questions at the begining of her lessons,during the lessons and after the lessons; She conveyed information through explanations and demonstrations and gave learners class activities and provided feedback. Below are few examples that indicated that Jane asked questions and conveyed informations which was appropriate for mixtures, classification of mixtures and methods of separation.

- **Jane:** we are now busy with separation of mixture. The first thing that you need to know is the terminology. What is a mixture? I know that you have done this in grade 6 (concept, initiation, authoritative, prior knowledge)
- **Nduvho**: is objects that are mixed together.
- **Jane:** a mixture is when two or more substances are put together (Content knowledge, prior knowledge)
- **Jane:** can you give me the examples, what is it that you can mix together? (sequencing ideas, prior knowledge)
- **Learners:** sugar and water; cement and sand (learners responses)
- **Jane:** 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 (Content knowledge)
- **Jane:** we can classify the materials of a substance that we want to put together to form a mixture. (Authoritative, sequencing ideas)
- **Jane:** some of the substances are pure and if something is pure it means that it is not mix with anything it is alone (Content knowledge, sequencing ideas)
- **Jane:** water itself it is pure. I have water here (jane poured water to the empty bottle of colddrink), can't you see that this water is pure does it have any colour or any colorant? (Authoritative, Subject Matter Knowledge).
- **Jane:** Another method of separation, we have filtration. She used example of muddy water for learners to understand filtration method without having difficulty and Jane first cut a 2- litre empty bottle of cool drink with a pair of scissors to make a filter funnel (concept, Subject Matter Knowledge, sequencing ideas)
- **Jane:** you take that muddy water and use this funnel then have a cotton wool and you press it. when you pour the muddy water, pure water will go down and the dirty things will remain on top and that method is called filtration (Subject Matter Knowledge, concept)
- **Researcher:** Jane was not having muddy water and cotton wool but she demonstrated filtration method as if she was having muddy water and as if the cotton wool was placed and pressed on a filter funnel.
- **Researcher:** Jane used content knowledge to explain a separation method

- called decanting. When water and oil were on the same object, oil was on top whereas water was at the bottom of the object (learners saw that oil float).

Context

Jane attended natural science workshops organised by the department to expand her knowledge on the subject under exploration. Jane was aware that most of learners are from poor family background and they depend on social grants. Their parents couldn't provide them with additional resources to support their learning. The resources that the school provided to Jane to support her classroom practices were textbooks, chalks, chalkboard and duster.

However, during her classroom practices Jane beside using the resources provide by school she organised other teaching aids such as rice, beans, salt, rice cooking oil, empty botltles of colddrinks and jug. These resources assisted learners to understand the natural science concepts without difficulties.

Some of the parents are not able to assist their children with their school activities like homework, projects and investigation because they were illiterate. Therefore, Jane mostly give learners classwork and homework was limited as she noted that learners do not write the homework. So she preferred classwork than homework. Hence, jane switch from English medium of instruction to learners home language. Few examples that revealed that Jane was aware about the family background of her learners and which resources could be useful to support learners to learn the ideas of lessons taught.

- **Researcher:** What is the socio-economic background of your learners?
- **Jane:** 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 eating 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 a task they come back without doing it. Why? because there is no one behind them at home (socio-economic background of learners)
- **Researcher:** What are the resources available to your school to support your teaching?
- **Jane:** We have the textbooks that we are given by department. We also have the computers that the donors had donated to a school (resources available at school to support teaching).
- **Researcher:** what resources are you going to use during today's lesson?
- **Jane:** I am going to use the grains, like beans, textbooks, chalkboard, salt, cooking oil, bottles of cool drinks, scissors, chalks, sieving and learners themselves (resources to be used during the lesson)
- **Researcher:** Beside the resources you used. What other teaching resources can you use to teach the same concepts and how will you use such resource?
- **Jane:** I think I can use videos because I see it somewhere being used that it is fruitful. Learners will watch the video while it is being played then learners will be talking or taking notes. We stop the video and then discuss what they have seen then we continue from where we stop and then after that learners will go and work on their own in their activity books (resource knowledge)Learners understanding
- **Researcher:** what support is provided to you as a Natural Sciences teacher?
- **Jane:** The department is giving us workshops and also it is providing some reference books and also the textbook it is trying to bring.

Learners understanding

Jane was aware on what to do for learners to be engaged in the lessons. Learners were asked questions that required their prior knowledge and the new knowledge provided by their teacher on the topics. Learners gave answers to most of the questions asked. All the lessons that was conducted included hand-on activities and that increased learners participations. Hence, teachers demonstrated some ideas of the lessons and learners were also given opportunity to demonstrate as well. These encouraged and motivated learners to have an interest on the lessons and stayed focused.

Most of the activities jane did in the classroom learners were given chance to do the same activity, for examples explaining terminology using textbook, demonstrate the ideas of the lessons. Jane diagnosed learners understanding on the content taught through questioning and written work i.e., classwork which was marked with the learners. Below are few examples of activities performed in the classrom

- **Researcher:** how will you make sure that all your learners stay focus and participate during lesson?
- **Jane:** The best way is to involve learners in the lesson by pausing questions in the beginning of the lesson, allow them to answer, to participate, and put them closer to you by giving them activity to do. For example, let them search for the word, I mean the terminologies. Let them look from key words that are inside the textbooks. Let them write the class work. Then you will grasp their total participation in the class (learner interest)
- **Researcher:** what aspects did you keep in mind when you plan a lesson?
- **Jane:** I think to me learner achievement is the best. My first aspect, what is that my learners are going to achieve? Learners should be able to apply this knowledge in their day to day life. They should be able to know what a mixture is. For example, how they are doing it. When they do something at home, how are they

going to do it? I have to cook, how they are going to do it. When they have to separate, how are they going to do it? I think what they achieve is the best (learner interest)

- **Researcher:** How do you know that learners learned or gain a better understanding of what you taught them?
- **Jane:** After teaching I must give them (learners) exercise so that I can see how far or am I not leaving them behind. Then after that exercise and marking it, it will help me to find whether learners are with me or I'm missing them (learner interestunderstanding)
- **Researcher:** What ideas did you expect your learners to learn?
- **Jane:** The ideas that I'm expecting my learners to learn that is the mixture. The meaning of the word mixture. They must know the physical properties of a mixture. They should also be empowered to know the physical properties in their day to day life. When they are doing something at home they must know that I have mixed something and also they have to know how we can put things together to form a mixture (concept, knowledge, learner interest)
- **Researcher:** Why it is important for learners to learn and understand the ideas?
- **Jane:** Today's learners or today's children are failing even to make tea. They don't know that they have to mix things. Then I think that is important because when they learn about mixtures they will also be able to know that this and this must not be put together because they will bring another mixture which is maybe sometimes you find that it is dangerous to them. Then they must know that we have to do things in the correct way (teacher knowledge-learner interest)
- **Researcher:** What prior knowledge do your learners need to have to learn such ideas?
- **Jane:** The prior knowledge that they must have it must be from their previous class grade 4, 5, 6 more especially in grade 6, then it is where they have acquired the first knowledge that when we put 1 and 2 together they are now a mixture (subject matter knowledge, experience)

Case 2: Kay

Content

Kay lessons focused on physical properties of materials and their impact on the environment which fall under natural sciences knowledge strand of matter and materials. kay subject matter knowledge was develop through natural science workshops conducted by the department and his teaching experiences because he did not specialized with natural scinces in his teaching qualification. Kay specialised in geography and Tsonga in his teaching qualification. However, the subject matter knowledge that Kay displayed during his classroom pracices was appropriate and organised.

At the beginning of all his lessons, he first introduced the topic of the lesson and mentioned the purpose of the lesson, thereafter asked questions based on the topic. Kay reminded his learners what they already know on the topics through questioning and that enable learners to link their prior knowledge and the new information related to the topic. Learners were able to give responses on the questions asked using their prior knowledge and new information provided by the teacher during the lessons. Moreover, he was able discover what learners remember and understand about the topic.

He empasised the links learners need to make with the topics inorder for learners to achieve a better understanding of the ideas of the lessons. Kay subject matter knowledge was appropriate as he was able to assess learners by posing questions at the beginning of the lessons, during the lessons and after the lessons. Beside questioning, he conveyed information through explanations and illustrations and gave learners class activities. Below are few examples that indicated that kay asked questions and conveyed informations which was appropriate for properties of materials and their impact on the environment.

- **Kay:** what is matter? (He used questioning techniques to arouse interest and engage learners).
- **Hope:** something that takes up space and has mass (answer).
- **Kay:** matter is anything that occupies space and has mass. Anything that occupies space has weight (lecture, interact-authoritative).
- **Kay:** in our class we have got different materials. Some of the materials they are hard whereas some of the materials are soft, some of them (materials) they are somewhere between hard and soft (subject matter knowledge, lecture method used to make learners understand the concepts).
- **Kay:** identify all those materials that we have here in the class (initiation, question)
- **Learners:** table; chalkboard; chair; further duster; said desks; papers; brooms; school bags; shelves; buckets; scissors (responses of different learners)

- **Kay:** the book that is in front of you there. If we made it out of let say the iron or the steel, what do you think it will happen? The book you see, you can open it properly, easy to bend, smooth (the teacher was opening the book), we can write on it nicely, therefore we take the steel to make a book (lecture-demonstration methods)
- **Kay**: we have got different materials that can be used to wrap the food. Obviously we're using different types of materials to wrap the food (the learners were told they can go to the shop, restaurant to buy fresh food, any kind of food that they like). But in term of wrapping there are different materials that can be used to wrap the food(Lecture method).
- **Researcher:** Kay used figures of different materials to wrap food on page 67 of the platinum grade 7 Natural Sciences learner's book to ask learners questions.
- **Kay:** let's identify material number a-d (initiation)
- Learners: a) clip wrap, b) plywood, c) paper and d) learners said wax wrap (responses obtained from different learners)
- **Kay:** which one out of the four do you think is more suitable to wrap the food? And you give me the reason (interact, authoritative)
- **Kay:** for example there are visitors or you're about to receive visitors from Gauteng is Good Friday. They want to visit or they're visiting your area therefore you are preparing food for them which one do you think we can choose to wrap the food and why? (example, authoritative)
- **John:** A cling wrap (response)
- **Kay:** what is the main reason for choosing A why not B? (interact, evaluation)
- **Charity:** because A is easier to wrap than B (response)
- **Leon**: A because its clean and no dust will get in(response)
- **Rose:** A, because is more flexible than b (response)

Context

Kay attended natural science workshops which are organised by the department to increase his knowledge on natural science subject. Kay knew that most of his learners came from poor family backgrounds and their parents are not educated. The resources that the school provided to kay to support his classroom practices were textbooks, chalks, chalkboard, charts and duster. During his classroom practices kay beside using the resources provide by school he used materials that were available in the classroom such as desks and chairs. Hence, such resources assisted learners to understand the natural science content better. Therefore, kay in his lessons the class activity was done through question and answers method and no class activity was done by the learners in writting. So he preferred giving learners class activity in a form of question and answer method that written class activity. Few examples that revealed that kay was alert about family background of the learners and which resources are available at the school that could be useful in supporting learners to learn and understand the ideas of the lessons better.

- **Kay:** It is very poor. The main thing that let it to be poor is that they are not close to things (socio-economic background of learners)
- **Kay:** We have got only books, some charts and we also use objects that are available around here at the school (resources available to support teaching)
- **Kay:** The objects in the class (resources to be used)
- **Researcher:** Besides the resources you used. What other teaching resources can you use to teach the same concepts and how will you use such resources?
- **Kay:** The related objects, any objects that I found that is related to the lesson that am teaching then I just pointed them and let them feel it, touch it (resource knowledge)

Learners understanding

kay was acquainted on what he can do for his learners to participate during his classroom practices. Kay asked questions that needed learners to employ their prior knowledge and new knowledge delivered by their teacher on the topics. Hence, learners were able to respond to most of the questions asked. All lessons conducted incorporated illustrations activities and that improved learners participations in the classroom.

kay used illustration and demonstration method to empasised some ideas of the lessons and learners were also given opportunity to explain the ideas of the lesson using illustrations on their textbook. Such activities motivated learners to have an interest on the lessons and engaged in the lessons.

Most of the activities kay did in the classroom, the learners were given chance to do the same activity, for examples explaining the ideas of the lessons using illustration in their textbook. Kay diagnosed learners understanding on the content taught through questioning and class activity which was carried out through question and answer method. Below are few examples of activities performed diring kay classroom practices.

- **Kay:** By involving everyone in the class. By asking them questions and then they respond (learner interestunderstanding)
- **Kay:** I want those people (learners) to take care of the objects around them(teacher knowledge-learner interest)
- **Kay:** they must know that things come from primary activities into secondary activities therefore until secondary activities, the secondary activities (prior knowledge, experience).
- **Kay:** can you give me some of the uses of the desks (initiation, prior knowledge)
- **Happy:** to seat on it (prior knowledge-experience)
- **Kay:** or what? (question)
- **Jack**: to write (knowledge-experience)
- **Kay:** it helps you to write (interact-authoritative)
- **Kay:** what is it that makes a ruler? think you also have a ruler in your bags, check (initiation, interact-authoritative)
- **Shawn**: plastic(response)
- **Rose**: wood (response)
- **Hazel:** iron (response)
- **Kay:** it means we have the other one that is made out of wood, the other one out of iron, the other one out of plastics, right (authoritative-interact)
- **Learners**: yes. (interact, response)
- **Learners**: instead of using sand to build houses we can use metal (prior knowledge, experience).
- **Kay:** just like here (the teacher touch the wall of the classroom) this are not sand, what materials are this once? (interact-authoritative)
- **Learners:** others said aluminium and others said wood (misconception, difficulty)
- **Kay**: is it a plastic? Is it a wood?(difficulty, dialogic)
- **Learners**: copper, some again said plastics (misconception, difficulty)
- **Kay**: it is a wood, check where there was a scratch as it is painted (incorrect subject matter knowledge, misconception)
- **John:** stainless steel (most learners agreed, misconception)
- **Kay:** stainless steel because they are of different in terms of strength (misconception, difficulty).

DISCUSSION

Case one (Jane)

The subject matter knowledge of Jane in the teaching of natural science was gained through workshops and teaching experience as she did not specialized with natural sciences in her teaching qualification. However, Jane was able to deliver all the lessons on mixtures and methods of separations in such way that learners understand subject content. Furthermore, Jane provided additional resources for demonstrations purposes in the lessons she conducted to assist her learners to understand the lesson taught without difficulties.

Jane did a lot of explanation in the lessons and such explanations had assisted learners when answering questions their teacher asked during and after the lessons. It was noted that learners were given an opportunity to employ their prior knowledge and the knowledge was connected to the new knowledge on the topic. Jane did used her subject matter knowledge to teach mixtures and method of separations separating of mixtures in a way that allowed learners to practice their thinking skills as they were asked to explain few terminology. However, the researcher noted that jane did a lot of explanations and questions in order to assist his learners to understand the lessons ideas.

The researcher detected that Jane asked the learners what is to separate when she was placing the books close to each other and such resulted in misconceptions as few learners thought to separate is to put things together. Such demonstration was not appropriate as it confused other learners in the classroom. However, one of the learners in the classroom manage to respond what is to separate in a correct way even though the demonstration displayed was confusing. Some of the learners in Jane class came from rural area where the school was located and most of these

learners were from a poor family background and their parents are illiterate. Furthermore, these parents are unable to assist their learners with school activities like homework and they failed to provide additional resources to support their children natural science education because they depend on social grants.

Jane sometimes code-switched from English medium of instruction to learners home language i.e., Tshivenda when explaining some of natural science concepts during her classroom practices. By so doing, Jane increased learner participations and that assisted the learners to learn and understand the concepts better. Even though it was useful, code-switch to Tshivenda home language may also disadvantage the learners because learners are assessed through English medium of instruction, for examples examinations are carried out in English.

Learners were able to used their prior knowledge when answering some of the questions asked and that allowed Jane to diagnosed what learners already know and where they still need support or clarity. Most of the activities conducted in the classroom encouraged learners to fully participate in their learning. For examples, learners demonstrate the ideas of the lessons, used textbook and their prior knowledge in explaining terminologies and write classwork.

Case two (Kay)

Kay did attended workshops to improve his knowledge on natural sciences as natural science was not one of his school subject he majored with in his teaching qualifications. Hence, his subject matter knowledge developed through workshops and his teaching experienced. This means that kay was offering natural science even though it was not part of his teaching qualification. Kay taught his natural sciences lessons by conveying information by means of questioning and explainations. However, most of his explanations was done by means of illustrations displayed in the textbook and few demonstrations he during the lessons.

Kay did not use the chalkboard in all his lessons and that can disadvantage his learners as they may not able to recall everything he taught them. However, it could have been a good idea for Kay to write some notes on the chalkboard for learners to copy so that they can be able to reflect on such information when studying for the topics taught on their own. Even though the teacher did not write anything on the board about properties of materials and their impact on the environment, learners manage to write some of the information he taught them on their notes book.

Kay lessons on properties of materials and their impact on the environment was taught through questioning, explanations with illustrations, demonstrations and examples. By so doing, his learners found it easier to involve themselves in the lessons taught. However, the lessons could have been more appropriate if some of the ideas he explained to his learners were written on the board for learners to copy. Unfortunately, Kay did not see the important of writing notes on the chalkboard. However, it was noted that almost all the learners participated in the lessons becaused they answered the questions and explained some of lessons ideas. Learners used their prior knowledge and the new knowledge their teacher provided when responding questions asked and explaining lessons ideas in the classroom

CONCLUSION

What is the nature of the teacher's subject-matter knowledge in the teaching of natural science?

Case 1 (Jane). In this paper it was revealed that Jane hold a qualification of Senior Primary Teacher Diploma where she majored with mathematics, biology, English and Afrikaans. This means that Jane used knowledge she gained through natural science workshops organized by the department and her teaching experience when teaching natural sciences to her learners. Therefore, the subject matter knowledge that Jane used to explain some of the concepts was obtained during content workshops she attended. Jane did in some cases demonstrated incorrect subject matter knowledge and misconceptions to the learners and such ideas learners failed to notice as such knowledge was not questioned by learners. Jane's subject matter knowledge were mostly employed by means of questioning and explanations. Learners were sometimes given an opportunity to exercise their cognitive thinking skills during the lessons. Therefore, Jane subject matter knowledge allowed learners to participate, learn and understand the concepts taught as Jane sometimes switched from English instruction to learners' home language which assisted learners to gain a better understanding of lessons concepts.

Case 2 (Kay). The study discovered that Kay had a teaching qualification of a Post Graduate Certificate in Education where he majored in geography and Tsonga. Natural science was not one of the subject he specialised with in his qualification. However, his subject matter knowledge was appropriate and organised. The researcher assumed that Kay's subject matter knowledge might have been developed through workshops he atended which were organised by the department and also by the experience he had on natural sciences teaching. Kay was able to asked

questions that allowed learners to employed the knowledge they learned previously about the topic and the new infomations he provided for them. His knowledge about the subject enabled him to evaluate learners understading based on prior knowledge and new new knowledge on the topic. However, kay did not consider writing notes for learners on the chalkboard and that could hinder learners perfomance because learners may fail to remember everything they learnt in details without having the notes to reflect on. The subject matter knowledge used by the teacher to explain the lessons concepts did allowed learners to answer the questions asked.

RECOMMENDATION

The study purpose was to explore teacher subject matter knowledge in senior phase natural sciences. The study findings provide evidence that there are areas in the teacher classroom practices that need to be developed and improved. Below are recommendations of the study based on the findings of the study and suggestions for further research:

- It is recommended that the Department of Basic Education should see that qualified teachers are available at schools for the proper teaching and learning of natural science.
- It is recommended that the Department of Education should provide necessary resources other than textbooks to support teachers during their classroom practices.
- It is recommended that subject teachers should improvise teaching materials that will enable learners to visualize natural science concepts such as videos.
- It is recommended that departmental meetings at schools should be taken into consideration for departmental head and teachers to share ideas on natural science subject, resolve any issues related to natural science and seek necessary assistance from subject advisors. Additionally, departmental head should monitor teachers within their department.
- It is recommended that natural science teachers, departmental head, and subject advisors work should work together for meaningful learning.
- It is recommended that sufficient workshops on subject matter knowledge should be conducted on how teacher should approach natural science topics.
- For further exploration, the researcher recommends that similar studies should be done across all grades offerering natural sciences.

Limitations

The study focused on two natural science teachers from two rural primary schools in Vhembe district, Limpopo Province. Hence, the finding of this study cannot be generalised to other schools' natural science teachers in the district. However, through explanation provided in data analysis, the finding may be significant to other districts with similar contexts.

Acknowledgements

I would like to acknowledge the teachers from the Vhembe district who participated in the study.

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