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AUTHORS: Thuli Gladys NTULI,Tebogo NKANYANI,Lettah SIKHOSANA,Awelani V MUDAU

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Research Article

Exploring Teacher Knowledge in Natural Sciences *

Thuli G.NTULI [1] **Tebogo E.NKANYANI** [2] **Lettah SIKHOSANA** [3] **Awelani V-MUDAU** [4]

Abstract

This is a qualitative interpretative case study. Its aim is to explore the teacher knowledge of senior phase Natural Sciences teachers. The following question guided the study: What is the nature of teacher knowledge of natural sciences teachers in the senior phase? Semi structured interviews and observations were used to collect data from three purposefully sampled participants. The findings reveal that senior phase teachers have limited content knowledge and inadequate subject matter knowledge and this enflamed misconception which could be transferred to their learners. It is therefore prudent to recommend a re-focus in the in-service teacher training and colleges of Education to improve teacher's subject matter knowledge and pedagogical content knowledge as they could be a barrier to effective teaching and learning and learner's performance in Natural Sciences.

Keywords: Teacher knowledge, subject matter knowledge, pedagogical content knowledge, misconceptions, natural sciences

1. INTRODUCTION

South African government is moving towards an enormous change, which is increasing the intake of learners in the STEM (Science, Technology, Engineering and Mathematics) field. However, for this enormous change to be plausible there are required number of aspects that must be considered such as adequate teaching and learning resources and most significantly teachers with adequate teacher knowledge. Teacher knowledge has been a focus area for many researchers and scholars after Shulman's (1986) work. This is evidenced by numerous studies conducted on teacher knowledge every decade such as: Grossman and Richert (1988), Ben-Peretz (2011), Mudau (2016), Nkanyani and Mudau, (2019), and Ntuli (2019).

Shulman (1986) branded teacher's knowledge in three categories namely: as content knowledge, pedagogical content knowledge and curricular knowledge. He further referred to teachers' content knowledge as "the amount and organization of knowledge per se in the mind of the teacher", which he clarified as a knowledge which is more than a mere understanding of a subject matter. Shulman (1986) further noted that teachers are anticipated to not only comprehend the content but also what is it and why is it like that and further justify their beliefs about what they understand. Shulman (1986) defined pedagogical content knowledge as "the subject matter knowledge for teaching", which comprised of how ideas were represented and made understandable to learners. He also noted that the understanding of learners is one of the vital component to pedagogical content knowledge as he argued that learners do not appear as "blank slates" as they come with preconceived ideas. The third category of teachers' knowledge was curricular knowledge, which, Shulman (1986) described as "the

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[1] *Dr., University of South Africa, South Africa, entulit@unisa.ac.za*
[2] *Lecturer, North-West University, Africa, South Africa, Eddie.Nkanyani@nwu.ac.za*
[3] *Dr., University of South Africa, South Africa, esikhol@unisa.ac.za*
[4] *Prof.Dr., University of South Africa, South Africa, mudauav@unisa.ac.za*
[*] *Corresponding Author e-mail adress: entulit@unisa.ac.za*

instructional materials", which he referred to as textbooks, visual materials, laboratory demonstrations…" (p. 10).

From the above Shulman's definition of teacher knowledge, it is clear that the teacher needs all three kinds of knowledge's to be able to teach natural sciences effectively and be regarded as a qualified teacher. However, that is not the case with most of the South African teachers' particularly natural science teachers as it is revealed by the study of Mudau (2016), Nkanyani and Mudau, (2019), and Ntuli (2019). The findings of these studies indicated that natural sciences teachers have weak content knowledge (CK) and inadequate subjected matter knowledge (SMK) as they only teach the content without understanding. Further to that these studies highlighted the unavailability of teaching and learning resources in some of the South African schools. These findings could be one of the reasons of why there's less intake in STEM subjects in South African schools and poor performance to those who enrolled them (Sedibe, 2014). With these challenges at hand, it is clear that South African government is yet to have an envisioned number of students in STEM field as there are still enormous challenges that need immediate attention.

1.1. Literature Review

Teacher knowledge of the Natural Sciences is one of the imperative aspects (Diamond, Maerten, Rohrer, & Lee, 2014) teachers have based on their personal experiences in teaching (Rohaan, Taconis & Jochems, 2012). It is a consequence of blending understanding and transferring experience (Kolb, 1984 in Carrier, Tugurian & Thomson, 2013). It has an absolute impact on learners` achievement of outcomes of learning (Diamond et al., 2014). It gives teachers a direction on how they should conduct themselves (Rohaan et al., 2012) and in choosing relevant teaching strategies when going to class (Halai & Khan, 2011). Strategies that can have a positive effect, if chosen well, for a successful and meaningful teaching and learning.

Shulman (1986) identified among others, three domains of knowledge when teaching: subject matter knowledge (SMK)/content knowledge (CK), Ppedagogical Ccontent Kknowledge (PCK), and curricular knowledge. In contrast, Grossman`s (1990) model of teacher knowledge as cited Rohaan et al., (2012) indicate four domains: SMK, general pedagogical knowledge, knowledge of context, and PCK. Shulman (1986, p.9) terms CK, "the amount and organization of knowledge per se in the mind of the teacher". The teacher must able to retract "substantive knowledge" s/he had attained on his/her academic journey (Starkey, 2012, p.94). This study will focus on teacher knowledge of senior phase Natural Sciences teachers.

1.1.1. Teacher knowledge in the South African basic education context

There is great concern with the level of content knowledge teachers take to class. Studies show that through assessments, content gaps have been spotted and strategies need to be created to close this gaps and consequently enhancing proceedings in class (DBE, 2015). Moreover, Ventak and Spaull (2015) indicate that report by SACMEQ III (2007) show a serious concern in the teacher content knowledge level. The study indicates that Grade 6 Mathematics teachers failed to answer questions which were meant for Grade 6 learners, with some of the learners getting better marks than teachers (Ventak & Spaull, 2015). It evident from this point of view that there are teachers who dessimate to learners in class, knowledge that they themselves do not have. Further, it raises eyebrows that elementary school teachers indicate considerable aperture in their Science Content Knowledge (SCK), consequently barring adequate teaching (Diamond et al., 2014). Leta, Ayele and Kind, (2021) support that notion by indicating that Physics teachers in their study failed to demonstrate CK in their teaching. Consequently, these misgivings have a negative impact on teaching and learning since teachers who have adequate understanding of CK will develop effective PCK (Rollnick & Mavhunga, 2016).

The teachers' understanding knowledge deals with "the knowledge of learners` prior knowledge, linguistic abilities, and learners` interests as well as their misconceptions" (Mudau

2016). If provided in sufficient quantity as required, it will be crucial in "interpreting reform ideas, managing the challenges of change, using new curriculum materials, enacting new practices, and teaching new content" (Ball et al 2001 in Diamond et al,. 2014, p.636). However, study by Usak, Ozden, and Ingo (2011), report that teachers show insufficient amount of SMK. Moreover, Bartos et al., (2014) indicate a failure of teachers transferring their SMK to the classroom. This was further amplified by Nkanyani and Mudau (2019) who argue that teachers bring to class misconceptions while at the same time teaching subject matter, which is unsuitable for the grade. Further, the misconceptions can arise in class, if a teacher gives learners a lot of content at once during a lesson (Rosenshine, 2012). Moreover, despite some teacher carrying overwhelming amount of misconceptions, they also had no procedural knowledge in their physics teaching (Leta et al., 2021). The teacher's knowledge of content therefore, has to be of the highest quality in order to identify with certainty, the misconception associated with his/her topic in class. This current study has the potential of exploring teacher knowledge from two strands of natural sciences.

1.1.2. Conceptual framework

Since this study focused on exploring teacher knowledge in Natural Sciences which is one of the aspects in the Classroom Practice Diagnostic Framework (CPDF). It was imperative to use this framework as it best suited this study. The framework was developed after borrowing some aspects of the teacher knowledge from the (CPDF) developed by Mudau (2016). The Teacher knowledge component of the CPDF is what the authors elected to employ as a theoretical lens for this study. The teacher knowledge component is composed of content knowledge, student understand knowledge among others, which is the focus of this study. The teacher knowledge framework can be seen at Figure 1.

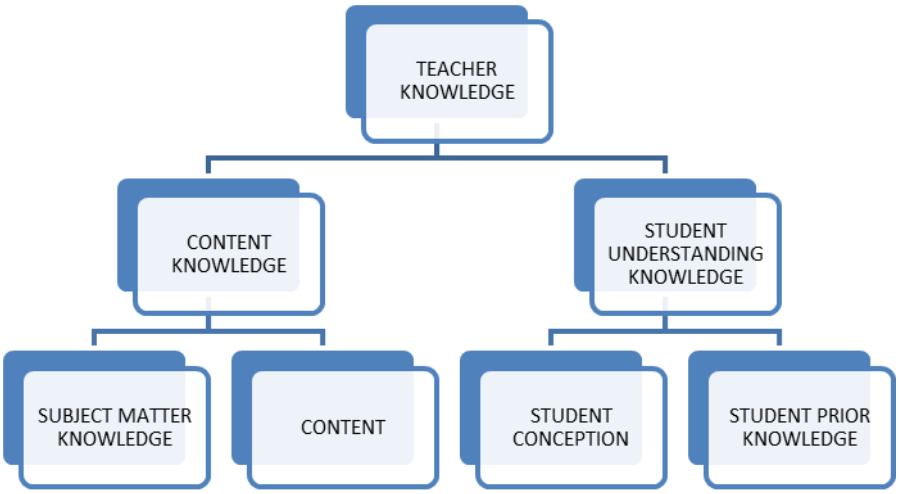

Figure 1. Teacher knowledge framework

1.2. Purpose of Study

The main purpose of this study was to explore teacher knowledge of natural sciences teachers in the senior phase focusing on two strands Matter and Material as well as Planet Earth and Beyond.

2. METHOD

2.1. Research Design

A qualitative research design was used in this study. Qualitative research design is an exploratory research used in describing, understanding and interpreting the phenomenon under exploration (Meriam, 2009). This design was used to develop in-depth understanding on how teachers

use their teacher knowledge to shapes their natural sciences classroom practices. The study adopted interpretative case study approach in an attempt to comprehend teachers' knowledge and their implementation in senior phase natural science. Case study approach allowed researchers to look at the depth of the problem in order to attain concrete, contextual, in-depth knowledge about phenomenon under exploration (McCombes, 2019).

2.2. Sample

The study sample involved two teachers in Limpopo province and one teacher in the Mpumalanga province. For the purpose of this study, participants were sampled purposefully with a belief that participants have different background, qualifications and teaching experience. Patton (2002) defined purposive sample as a technique widely used in qualitative research to identify and select-rich cases for the most effective use of limited resources which must be consistent with the study aim. This involves identifications and selection of participants that are knowledgeable about and experience with phenomena of interest (Cresswell & Plano clark, 2011). Consequently, by purposive sample researchers included three senior phase natural sciences teachers from secondary schools situated in Limpopo and Mpumalanga province to participate in the study.

2.3. Participants

Three teachers participated in the study were three males. Hence, the names appeared in the study are pseudonyms and this was done to protect participants' identity. Moreover, the participants have different teaching qualification and experience. Table 1 below, summarize participants' demographic details:

Table 1. Demographic details of participants

Cases (short abbreviation)	Participant pseudonyms	Gender	Qualification/s	Overall teaching experience in years	Teaching experience in natural science in years	Post level	Type of school
Case 1/natural sciences/participant 1 (c1/ns/p1)	Mr john	Male	Diploma	4	4	1	Combined school
Case 2/natural sciences/participant 2 (c2/ns/p2)	Mr marula	Male	Ptd, Ace	18	6	2	Public school
Case 3/natural sciences/participant 3 (c3/ns/p3)	Mr kay	Male	BA, PGCE(sp &FET)	6	6	1	Public school

2.4. Data Collection Methods and Instruments

2.4.1. Observation

Creswell (2012) reported observation as a process of collecting first hand data in the research site by means of observing participants. An observational tool collected data during lesson observation and lessons were video-recorded to ensure accuracy of the data collected. Researchers obtained Participants' consent prior to lesson observation in order to ensure reliability and to avoid mistake of data collected during the process of analyzing data. The researchers were non-participants observers. Non-participants observer involves observing participants in the research site without actively participating in the activities (Singh, 2014). The researchers observed participants in their classroom and learn about the activities conducted without interfering in any of the activities. Researchers used

video recorder to capture data of the entire lesson process and researchers ensured that the data were transcribed and analysed accordingly.

2.4.2. Interview

Semi-structured interview tool was used as data collection technique for this study. Semi-structured interview is a technique of qualitative data in which the questions to be asked interviewees are constructed by interviewers before the interview process commences. Dejonckheere and Vaughn (2019) described semi-structured interview as flexible structure of interview which allows researchers the opportunities to probe and expand on interviewees responses if necessary. Audio recorder captured the data of the entire interview process and researchers ensured that the participants asked same open questions followed by further probing and clarification (Nieuwenhuis, 2016).

In this study, researchers conducted face to face interview with the participants where semi structured interview tool and audio recorder used for data collection. Additionally, researchers' first attained consent from participants for the purpose of ensuring reliability and avoidance of mistakes on information gathered during the entire study process. Researchers transcribed and analyzed audio-recorded interviews separately.

2.4.3. Validity

Leung (2015) indicated that in qualitative research design validity can depend on the accuracy of techniques used for data collection, procedures and information obtained from the participants. Interviews and observations used in the study to increase the validity of the study findings and reliability of results with the data (McMillan & Schumacher, 2010; Merriam, 2009). To ensure validity in this study, researchers presented interview and observational tools to seven natural sciences teachers who were not part of the study to ensure that they serve the purpose they were designed for. By so doing researchers invited corrections, comments, and additional information from the non-participants natural sciences teachers. Pilot study conducted with one teacher who was not part of the main study where both semi-structured interview and observational tool were tested to ensure they were valid. During pilot study process data analysis scheme (DAS) was developed and implemented. Moreover, researchers enhance validity of this paper by focusing only on data collected from all participants of this study.

2.5. Data Analysis

Data of the study collected from three cases were analysed and interpreted separately. Audio-recorded semi-structure interviews and video-recorded lesson observation were transcribed verbatim by researchers to a word document. Thereafter, researchers' replayed video and audio recorded in order to check if the words transcribed corresponded with what was on the recording devices. Moreover, researchers did not correct participants' grammatical errors in order to ensure that data collected from participants was presented accordingly and does not lose its original meaning. Henceforth, researchers presented each participant his or her transcribed data for corrections, comments and additions before being considered as a final product.

The data collected was presented in the form of case studies i.e. case 1, case 2 and case 3. Data Analysis Scheme (DAS) which was developed, implemented and confirmed during pilot study was used in analysing the data of this paper. McMillan and Schumacher (2010) 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. The themes proposed for this paper was adopted from reviewed literature, conceptual framework, research question and aim. We focused on teacher knowledge herein content knowledge and student understanding were themes. With organization amount of subject matter knowledge, linguistic abilities, misconceptions and prior knowledge were the

categories. Data interpreted and analysed focused on the themes proposed for the paper and each theme included each categories and characteristics. Moreover, for the purpose of this paper, data relevant to study themes were considered and assisted researchers in answering research questions and achieving the aim of this paper.

3. FINDINGS

The results of each cases were presented separately as single case as our intention were not to conduct a comparative study but to have an in-depth understanding of each cases within their own context. The following keywords and symbols were used to present cases of each participant:

Case 1/ Participant 1/Natural Sciences= MR JOHN

Case 2/Participant 2/Natural Sciences= MR MARULA

Case 3/Participant 3/Natural Sciences= MR KAY

3.1. Teacher Knowledge

Case 1: Mr John

It was imperative for the purpose of this paper to tap into what the teacher understands about matter and material as one of the strands of Natural Science subject. Mr John displayed a limited content knowledge (CK) and poor subject matter knowledge (SMK) during the interviews as the question was posed on what was the periodic table is all about. He had indicated that it was the topic he was going to teach. John said:

"Periodic table is nothing a way in which elements are ordered and grouped according to their behaviour." Mr John

Drawing from the above extract it shows that Mr John had an idea of what the periodic table is, however his knowledge was partial and limited as he only indicated that the periodic table is about elements and their behaviour, however there is more to it than that. There are many concepts embedded within the periodic table as shown in the NS CAPS document such as the three main categories in which elements are arranged and their properties.

Mr John was observed starting his lesson by showing an organised content knowledge (CK) as he explained the terms of an element and matter to learners as per expectations, according NS CAPS document. Mr John further explained to learners who devised the periodic table. This is evidenced by the extract below from the observation.

"There was this Russian by the name Dmitri Mendeleev, when you read this Dmitri Mendeleev he was a Russian, in 1820 that's when he discovered or that's when he come up with this periodic table in 1820 many many years ago. So he came up with this periodic table and who is this person Dmitri Mendeleev who was a Russian. But after him, there are so many scientists who wanted to come with new things new ideas on top of what this Russian Mendeleev has already discovered." Mr John

He further explained to learners that the periodic table is divided into three main categories and said:

"And so according to this periodic tables, we have metals, we have non-metals and we have semi-metals" Mr John

This indicated that even though John did not mention these categories as concepts that are part of the periodic table during the interview, he did know about them. He further explained where these three categories are situated in the periodic table and said:

"Metals are situated on a periodic table on your left-hand side, the non-metals are on your right-hand side, that zigzag part, and those are the semi-metals." Mr John

As the lesson proceed John displayed a limited content knowledge (CK) and poor subject matter knowledge (SMK) as he was observed telling learners about the groups and periods found in the periodic table and what they are used for. He said:

"There are groups and also we have the periods. Periods and groups are there also to show us where is metal situated and where non-metal is situated and where are the semi-metals situated"

From the extract above, it was confirmed that some of the Natural Science teachers show a limited amount of Content Knowledge (CK) and Subject Matter Knowledge (SMK). Mr John had an idea that there are groups, periods in the periodic table but due to his limited content knowledge (CK) he failed to explain which ones are groups, and which ones are periods and how to identify the two. Furthermore, this limitation hindered him from explaining the number of groups thereof.

3.2. Teacher Knowledge

Case 2: Mr Marula

It was imperative for the purpose of this paper to tap into what the teacher understands about planet earth and beyond as one of the strands of Natural Science subject. The teacher had irrelevant subject matter knowledge and failed to incorporate the Natural Science CAPS document in teaching and learning process. His irrelevant subject matter knowledge is evident in the statement below:

"When these spheres (pointing at the lithosphere, atmosphere and hydrosphere) interact with one another, they are going to make the biosphere" Mr Marula

It was apparent that the teacher chose to focus only on the latter which is the interaction between the three spheres and the biosphere and nothing was said about the interaction between the spheres themselves. Therefore, it is evident that the CAPS document was not incorporated.

3.3. Student Understanding

During observations, when he interacted with his learners we observed that his lessons was characterized by lot of misconceptions. This was evident during the question and answer session that he had with his learners below:

"And again we have got four spheres of earth, what are those?" Mr Marula

"Hemisphere!" Learner 1

Even though the teacher managed to do away with the above misconception, he ended up creating lot of misconceptions. At one stage referred to the lithosphere as the solid part of earth. When asked what he meant by his statement during post-observation interviews, he indicated that:

"Even though living organisms are solids, they are part of the lithosphere." *Mr Marula*

That in itself creates another misconception that all living organisms are found in the lithosphere. Moreover, his failure to explain clearly the relationship between the hydrosphere and lithosphere could have had the learners thinking that the two are the same.

The teacher visited irrelevant prior knowledge and it was insufficient. Furthermore, he went on probing questions on learners with content which was irrelevant to the topic that he was teaching. This is evident in the statement below:

"So now I want you to…I want us to go back. We know that in Grade 7 we learnt about the earth which is one of the coordinates of the world. Are we together. So what are the… what are the structure… what is the structure or what are the layers of the earth? What are the layers of the earth?" Mr Marula

Revisiting the correct and relevant prior knowledge could have helped learners to connect the dots and enjoy the teaching and learning process but that was not the case. In relation to context knowledge, the class was dominated by English language even though he in some instances used Sepedi to explain some concepts and relationships. This could have been a downside to his teaching since the language of teaching and learning is English. Furthermore, using Sepedi knowing that some of the English words are not available in their vocabulary, could have led to an incorrect translation in the learners` minds. He asserted that:

"*(In Sepedi) biosphere is where you see animals and people live together in the world just like as we are." Mr Marula*

It is clear from the teacher's utterances that his explanation in Sepedi could have best been explained in English. His explanation could have created misconceptions in the learners` minds that people (human beings) are not animals. In conclusion, it is evident that the teacher had irrelevant content knowledge, irrelevant utilisation of prior knowledge, misconceptions and poor context knowledge.

3.4. Teacher knowledge

Case 3/Participant 3/Natural Sciences= MR Kay Participants

For the purpose of this paper we had to focus on the classroom practice of the teacher in relation to matter and material as one of the strands for Natural Sciences. During the lesson presentation when the teacher taught about the topic of matter and material, we observed that the teacher has adequate content knowledge and subject matter knowledge. This was evident when he provided learners with adequate explanation of the topic and presenting the ideas in a sequence manner. He asserted that:

"Our lesson today that is properties of matter. The main purpose for this, that is to know all things that are responsible for making any different of materials that we have. So 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 right. The first thing that I want you to do, that is to identify all those materials that we have here in the class, can you identify them?" Mr Kay

Furthermore, he used content knowledge and subject matter knowledge that was adequate in the explanation of the concepts to the learners and he presented the sequence of ideas during the lesson as follows:

"*Matter is anything that occupies space and has mass, anything that occupies space and has weight. So 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 they are somewhere between hard and soft right. I want you to identify all those materials that we have here in the class." Mr Kay*

The teacher was observed referring to the Natural Science textbook when teaching. He did not take either a lesson plan or the Natural Science CAPS document along to assist to teach the particular concept. However, he used his subject matter knowledge to explain the different concepts. Therefore, it is evident that the teacher has adequate content knowledge and subject matter knowledge.

During lesson observations when he taught about materials, he requested learners to identify materials used to build the classroom. He engaged learners into question and answer session and this led to the development of misconceptions amongst them. This was evident in the statement below:

"*Yes instead of using what….sand to build what….houses we can use what ……metal? Just like here (the teacher touch the wall of the classroom) these are not sand, what materials are these once?" Mr Kay*

"*Aluminium* (others said) *wood" Learners*

"Is it a plastic? Is it a wood?" Mr Kay

"Copper, (others said) *plastics" Learners*

"It is a wood, check where there was a scratch as it is painted" Mr Kay

Some of these misconceptions were not attended to by the teacher. As result, this resulted into learners thinking that the ideas that they are providing were appropriate. We further observed the teacher revisiting prior knowledge when he was teaching. He reminded learners what they have learnt previously about the topic by asking them questions. He used prior knowledge to connect with new information on a particular concept and this assisted learners in understanding the ideas of the lesson as well as taking part in the lesson. This was evident in the statement below:

"*The first thing that we need to do, we must start with the word itself matter. What do you understand about this word that we call it matter? Do you still remember the first thing when we were*

in the beginning of our Natural science we have dealt with different spheres; do you still remember the spheres?, Lithosphere, biosphere, hydrosphere, and mesosphere. Then all those spheres we dealt with different matter. So there are matters that are found in the water, there are matters that are found on the ground, on the space in different places.so what is matter?" Mr Kay

Furthermore he also used his prior knowledge to enable learners to list the materials that were available in the class in order for learners to know and see the materials available around them. His emphasis here was for his learners to know that materials differ as some of them are soft, some are hard and some are in between. The teacher also used prior knowledge for learners to recognise that different materials can be used to make the same object. This was evident in a question and answer session below:

"W*hat is it that makes a ruler? The material that makes a ruler, think you also have a ruler in your bags, check.*" *Mr Kay*

"P*lastic, wood, iron." Learners*

"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." Mr Kay

Based on our findings, the teacher displayed adequate content knowledge even though there were misconceptions observed amongst his learners. Furthermore, he revisited the prior knowledge continuously to ensure that learners are able to understand the content being taught.

4. DISCUSSION and CONCLUSION

Natural Sciences curriculum consists of four knowledge strands which are life and living, matter and material, energy and change as well as planet earth and beyond (Department of Basic Education [DBE], 2011). This study was based on two strands, which is matter and material as well as planet earth and beyond. *Mr John* and *Mr Kay* lessons focused on matter and material while *Mr Marula* focused on planet earth and beyond. These topics were a part of the four knowledge strands as stipulated in grade 7 Natural Sciences CAPS document (DBE, 2011).

A study by Usak et al (2011) revealed that some of the Natural Science teachers displayed inadequate content knowledge and subject matter knowledge for this subject. These findings were evident when *Mr John* and *Mr Marula* displayed a limited amount of content knowledge and subject matter knowledge in their teaching and learning process. This is clear that they did not have an understanding of the themes and topics that needed to be imparted to the learners (Rohaan et al., 2012). This was observed with Mr John as he failed to explain to learners what are periods and what are groups on the periodic table and how to differentiate the two.

However, that was not the case with *Mr Kay* as he displayed adequate content knowledge and subject matter knowledge of Natural Science. *Mr Kay* emphasised on the links learners need to make with related topics to help them achieve a thorough understanding of the nature of and the connectedness in Natural Sciences (DBE, 2011). *Mr Kay* achieved this by looking for explanations and connecting ideas in a systematic way (DBE, 2011). That was not the case with *Ms Kate* and *Mr Marula*. *Ms Kate* did not teach the topics in a sequential order *(Acids, Bases and Neutrals; Arrangement of elements on the Periodic Table; and Some properties of Metals, Non-Metals and Semi-Metals)*.

While *Mr Marula* chose to focus on the latter which is the interaction between the three spheres and the biosphere and nothing was said about the interaction between the spheres themselves. As a result, a CAPS document was not incorporated as it clearly states that the content that needs to be taught, is how the spheres interact with another and how they interact with the biosphere (DBE, 2011). Therefore, it is evident that content knowledge can influence what teachers teach as well as how they teach it (Yilmaz-Tuzun, 2008).

The lessons presented by *Mr Marula and Mr Kay* were embedded with enormous misconceptions between the teacher and the learner. Furthermore, too much content was taught which resulted to misconceptions (Roseshine, 2012). These misconceptions led *Mr Kay* learners to believe that their answers were appropriate as the misconceptions that they had were not attended too. Such misconceptions could even block learners' effective learning of science (Burgoon et.al 2010). Furthermore, learners developed more misconceptions when *Mr Marula* decided to teach some of the content in IsiNdebele and Sepedi which led to incorrect translation.

P3/C3/NS revisited the correct and relevant prior knowledge which helped the learners to connect the dots and enjoy effective teaching and learning. However, that was not the case *Mr Marula* as their prior knowledge reviewed was not in line with the content taught. Hence, it is important to check learner's prior knowledge as it allows them to match the previous knowledge with the new emerging learning (Mesa et al, 2014).

The findings of this paper indicated that meaningful teaching and learning of senior phase Natural Sciences at schools it is weakened by a variety of challenges. Some of the challenges such as limited subject matter knowledge and inadequate pedagogical content knowledge are so vital that they hindered the teaching and learning process. This paper provide evidence that effective teaching and learning in the senior phase natural sciences is negatively affected by the existence of the above-mentioned challenges which resulted in misconception and poor context knowledge, which should be addressed. Therefore, based on the findings of this paper it is recommended that the Department of Education as an arm of government should conduct sufficient workshops on subject content in order to develop and improve teachers' knowledge on how to approach Natural Science content. Moreover, HOD's and subject advisors should monitor teachers' classroom practices in order to assist them where necessary as well as hold meetings with their teachers to share their ideas on the subject under exploration. The in-service teacher training and colleges of Education should adapt their curriculum and focus more on teacher`s SMK and PCK as they proved to be barriers of effective teaching and consequently learner`s performance in the NS.

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