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Natural Sciences Teachers' Experiences on Teaching Planet Earth and Beyond Knowledge Strand

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ABSTRACT

The aim of this study was to explore the teaching of senior phase of Natural Sciences with a focus on the Planet Earth and beyond knowledge strand. A qualitative case study design was used. Semi-structured interviews and observations were employed to collect data from two purposefully chosen teachers. The results of the study showed that some Natural Sciences teachers might lack the appropriate subject matter knowledge for the planet Earth and beyond knowledge strand for meaningful teaching. Moreover, teachers indicated poor knowledge of the context in specific aims and assessment strategies and chose poor and irrelevant instructional strategies. Furthermore, the teachers saw themselves as the authority figure in class and hence applied a dominantly teacher-centered approach. Therefore, it is recommended that there is a need to refocus on the in-service teacher training to improve teachers' subject matter knowledge as well as pedagogic content knowledge. The authors also recommend a large-scale study on the same strand.

Keywords: Teacher knowledge, natural sciences, instructional strategies, classroom discourse and interactions.

INTRODUCTION

The imbalances of South Africa's education system due to the apartheid government led to the introduction of curriculum 2005 (C2005), embedded in the principles and values of the outcome-based education (OBE) (Department of Education [DoE], 1997). The curriculum was implemented to replace the pervasive method of "rote learning" used during the apartheid by implementing learner-based methods that focused on critical thinking. C2005, however, received criticism due to its complexity. Among others, (a) short training period for teachers, (b) lack of practicality, and (c) lack of coordinators' professional training were problems with the C2005. The poor relationship between curriculum and assessment policy, inefficient availability of resources to implement the curriculum, and policy overload were also indicated in some reports (DoE, 2000). These problems resulted in teachers showing reluctance to

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implement the curriculum, ultimately failing to apply the curriculum in classrooms. The curriculum was then modified into the revised national curriculum 2005 (Revised National Curriculum Statement [RNCS], 2005) in 2002 (DoE, 2003), which reduced the complexity by focusing more on what leaners must gain in terms of skills and the knowledge and how they progress. In the RNCS 2005 design features were reduced from eight to three which were critical and developmental, learning outcomes and assessment standards (DoE, 2003).

Studies, however, have indicated the frustration that teachers had with the RNCS 2005 (Human Sciences Research Council [HSRC], 2009). According to the HSRC (HSRC, 2009), ineffective teacher training, poor implementation, and lack of sufficient resources were among teachers` concerns about the curriculum (HSRC, 2009). The teachers indicated the lack of desire and confusion embedded on stress and lack of intrinsic and extrinsic motivation, which led to them not performing in the classroom (DBE, 2009). Furthermore, researchers show that the RNCS was worsening the division in the outcomes rather than alleviating it (Ramatlapana & Makonye, 2012). The challenges and concerns about the RNCS paved the way for the Curriculum and Assessment Policy Statement (CAPS) (DBE, 2011b). CAPS is a learner-centered curriculum, where the teacher`s role is to control the learning process in line with the curriculum program (Umalusi, 2015). However, some studies indicate that the teacher`s role in the current CAPS has diminished (Umalusi, 2015). Researchers have found that teachers can perform their duties in classrooms by sticking to the implementers` programs. However, they may lose their freedom to design their type of lessons or alter the learning programs to suit the conditions in class or meet different learning types of learners (Umalusi, 2015). Moreover, teachers are deprived of their will of being autonomous (Ramatlapana & Makonye, 2012). This shows the level of difficulties the teachers face when presenting knowledge in class. Teachers need to be at their best when facilitating lessons, and in this case, that proves to be difficult, if not impossible.

Natural Sciences (NS) in the senior phase (SP) introduces learners to the further education and training (FET) subjects such as Life Sciences, Physical Sciences (Chemistry and Physics), and Geography (DBE, 2011a). These subjects are introduced through the strands including Life and Living (LL), Matter and Materials (MM), Energy and Change (EC), and Planet Earth and Beyond (PEB) (DBE, 2011a). NS serves as a foundation for the subjects mentioned above. Therefore, there is a need for well-qualified teachers to prepare learners for this bigger world. Furthermore, teachers need to be subject specialists (DBE, 2011a) in order to carry out the needed tasks. NS serves to prepare learners for the FET subjects; thus, there is a need to establish succinctly learners' performance in the FET subjects: Physical sciences, Life Sciences, and Geography.

According to the CAPS subject statements of both the NS (DBE, 2011a) and Geography FET (DBE, 2011a), Table 1 indicates topics that are common and form links between the NS syllabuses and Geography Grade 12 syllabus.

Table 1. *A link between the Natural Sciences and Geography Grade 12*

NS General Education and Training (GET)	FET Geography Grade 12
The relationship of the Sun to the Earth in NS grade 7	Climate and weather in Geography grade 12
Mining of mineral resources in NS Grade 9	Economic Geography of South Africa (Mining)
The Lithosphere in Grade 9	Drainage Systems in South Africa, Fluvial Processes, and Catchment and River Management

In Table 1, there is evidence about how the PEB strand in the NS forms a background for some of the Geography topics in the upper grades, specifically in grade 12. However, it is not only the Geography subject where topics have evident in the PEB strand of NS. Physical Sciences and Life Sciences are also home to some segments of the PEB strand, as indicated in Table 2 and Table 3 below.

Table 2. *Table showing the progression of GET NS PEB strand topics in the FET Physical Sciences*

GET NS PEB	FET Phsical Sciences
Gravity, on the Grade 7 topic: Relationship of the Moon and Earth	Gravitational potential energy in Grade 10, Newton`s Law of Universal Gravitation in Grade 11, and Vertical projectile motion in one dimension
Refraction and reflection appearing the subtopic of telescopes in the Grade 8 topic: Beyond the solar system	Geometric optics in Grade 11; and Doppler effect with light and photoelectric effect in Grade 12
The hydrosphere in the Grade 9 curriculum	The hydrosphere in Grade 10
The lithosphere in the Grade 9	Exploiting the lithosphere and Earth`s crust in Grade 11 curriculum

As can be noted in Table 2, some topics belonging to the PEB Strand of NS GET band that serve as a gateway to some topics in the FET Physical Sciences. In addition, those topics are assessed in Grade 12.

Table 3. Table showing the progression of GET NS PEB topics in the GET Life sciences

GET NS PEB	FET Life Sciences
The greenhouse effect in the Atmosphere topic of Grade 9	Greenhouse effect and Global warming in the topic: Human impact on the environment of Grade 11
Mining in South Africa from Grade 9	Loss of biodiversity through mining; and effect of mining on quality of water – both in Grade 11 curriculum

Similar to Physical Sciences and Geography, Life sciences also has topics that rely on the foundation from the GET NS PEB strand, as indicated in Table 3. The greenhouse effect and Mining in South Africa topics taught in Grade 9 in the NS are taught in more detail in the Life Sciences in Grade 11. However, they are assessed in gade 12 as "Environmental impact." There is evidence about how the PEB strand of the NS GET band provides foundations for some of the key topics in FET subjects like Physical Sciences, Life Sciences, and Geography.

Furthermore, even though a number of studies have been conducted on NS (e.g., Bantwini & Feza, 2017; Christensen & Rasmussen, 2017; Ramnarain & Chanetsa, 2016); and no studies have been undertaken concerning the PEB strand. Consequently, this study focuses on teacher knowledge, instructional strategies, and interactions and discourse in the NS classrooms in the PEB strand. The following research question guided the study: How does a senior phase Natural Sciences teacher teach the strand "Planet Earth and Beyond?"

The authors identified that most NS teachers showed high attention to topics from the PEB strand in the subject support meetings facilitated by subject advisors. Most teachers indicated struggles with activities and poor Geography background as the reason for the struggle. Some of these teachers were specialized in Physical Sciences and Mathematics from teacher institutions; thus, they had limited Geography subject knowledge. Therefore, there is a need to examine NS teachers' experiences in teaching in Geography subject strands including the PEB strand. The aim of this study was to analyze and interpret the experiences of teachers in teaching the PEB strand in the senior phase.

METHODS

In this study, a qualitative approach is utilized. The researcher's intention in this study was to explore teaching difficulties in NS. Therefore, an interpretive multiple case study design was used in which the context of the study was the teacher and his/her practice in class. Further, the reason for choosing a multiple case study was that the phenomenon under study involved more than one teacher (Mudau, 2016).

a) The Study Group

Two teachers, who found teaching the PEB topic difficult to teach, participated in this study. The teachers were identified during an NS workshop and meetings facilitated by the subject coordinators in one of the districts of the Limpopo Province in South Africa . Moreover, each chosen teachers had a teaching experience of more than six years. This criterion was used to make sure that the teachers had teaching experiences in at least two national curriculums, eliminating inexperience as a difficulty. Furthermore, the teachers had to be teaching Grade 9, since it was the last grade where NS was taught. NS in grade 9 is the class that gives final preparation for the FET classes; hence, it provides a gateway for FET subjects such as Geography, Physical Sciences, and Life Sciences. Table 4 summarizes the participants` demographics including teaching experiences and qualifications. Pseudonyms were used to represent the participants.

Table 4. *Table summarizing the participants` information on their gender, qualifications and teaching experience*

Pseudonym of teacher	Gender	Highest qualification	Overall teaching experience	Teaching experience in Natural Science	Post level
Mr P	Male	Primary Teacher's Diploma (PTD) Advanced Certificate in Education - ACE (NS)	24	10	2
Mr JB	Male	BEd	22	22	1

b) Data Collection Tools

Semi-structured interviews and observations were employed as data collecting tools for this study. A voice recorder (Ary et al., 2010) was used to capture the interviews and a video camera was used to grasp each activity in the classroom. Moreover, field notes were also taken during classroom observations.

The interviews were conducted in two forms: before the observations (pre-observation interviews) and after the observation (post-observation interviews). In the pre-observation interviews, the researcher asked participants questions about their qualifications and training, experience in the subject, their involvement in science, epistemological beliefs, and challenges they experience when teaching the topic/subject. Interview questions also included how the participant would teach the PEB topic of spheres of Earth and their relationships, how they would assess the topic, and where they would teach the topic [contextual knowledge]. They were further asked which types of instructional strategies they would employ when teaching the topic, the explanatory framework they would utilize, and their epistemological perspective (Mudau, 2016).

With regard to the qualifications and training section, the questions were based on participants` education history, major subjects, and training received through workshops on the subject. With the work experience, the focus was on years of teaching NS as a subject. The involvement of teachers in the subject focused on science from a broad point of view with emphasis on the projects the teacher had supervised including science expos. This was done to gauge the teachers` amount of interest in science. The last part of the data collection method, post-observation interviews, included interviews. These interviews were semi-structured in which most of the questions arose from the aspects of the observation, while some questions emerged as the interviews progressed (Ary, Jacobs & Sorensen, 2010).

c) Data Analysis

The interviews were transcribed from the voice recorder, comparing the contents of the audio records with the gestures and reactions of the participants noted down by the researcher. The field notes from the observation were typed for analysis. The transcripts and field notes were then read thoroughly to make sense of the evidence and grasp the logic of the participants. The ideas and opinions were written on the margins of the interview transcripts and field notes (Creswell, 2014). Coding was derived from research questions and reviewed literature. The following themes were emerged from the data; teacher knowledge, instructional strategies, and classroom discourse and interactions.

The Classroom Practice Diagnostic Framework (CPDF) by Mudau (2016) was considered as the framework for the study. The framework focuses on teacher knowledge, instructional strategies and interactions, and discourse as the components for classroom practices. The idea behind the framework is that a teacher`s NS content knowledge and contextual knowledge should allow him/her the leverage of choosing instructional strategies that are relevant to the PEB topic in the NS classrooms. The chosen approach, which includes traditional/non-traditional methods, epistemological perspectives, and explanatory frameworks, should give a choice on the types of discourses such as authoritative and/or dialogic discourses with the patterns of discourses. The most interesting part is that if the types of discourses are not effective, the teacher can always go back to select another approach that can yield efficient discourses and interactions. In other words, moving between these areas would be involuntary (Mudau, 2016).

FINDINGS AND DISCUSSIONS

Case 1: Mr. P

Mr. P was disorganized in the articulation of his knowledge. In his teaching, he was at one point teaching the targeted content but spent most part of the lesson giving learners irrelevant content. For example, he taught learners about the composition of the atmosphere and the dominance of Nitrogen, even though the topic was supposed to be taught at the end of the term. Therefore, his Subject Matter Knowledge (SMK) was poor (Rohaan, Taconis & Jochems, 2012) as it was not clear from Mr. P's statements about what the PEB strand was and what must be taught in the interviews. The NS CAPS document (DBE, 2011a) shows clearly that the topic "spheres of Earth" focuses on the four spheres (i.e., biosphere, lithosphere, hydrosphere, and atmosphere) and how these spheres interact with another. However, Mr. P chose to focus and talk about the shape of the Earth instead of spheres of Earth

MR. P: How is the Earth? (writing the question on the board), from the shape, how is the Earth? Heh?!! (makes gestures to the learners trying to give a hint of the shape)

Learner: Round?

He indicated that he wanted the learners to relate the word sphere with the shape in that it meant 'round.' This was incorrect as the Earth is spherical and not round. Furthermore, Mr. P continuously revisited irrelevant and insufficient prior knowledge throughout his teaching. This was a downside of his teaching since checking prior knowledge of learners in a correct way could allow him to match the learner`s prior knowledge with the emerging knowledge (Messa, Pringle & King, 2014) and create a conducive state for meaningful learning throughout the lesson (Aslan, 2017). Furthermore, prior knowledge is critical in a constructivist classroom (Doolittle & Hicks, 2003). Moreover, even though the teacher indicated some of the learners` misconceptions during

his interviews, none were identified and rectified during the lesson. However, as seen in the observations, the teacher gave a lot of content, which was irrelevant and outside the NS curriculum and created more misconceptions as a consequence (Roseshine, 2012).

According to Geelan (2003), explanation of frameworks are schemas that teachers apply when using "analogies, metaphors, examples, axioms and concepts" in teaching the topics in the PEB strand. This is also noted by Çepni, Ülger, and Ormanci (2017). The CAPS document for NS (DBE, 2011a) indicated that drawing and labeling of concentric layers as a way in which teachers can demonstrate the contents of the lesson on the spheres of Earth to the learners. Doing so can help learners in writing, modeling, investigating, discussing, naming, sequencing, dissecting, and researching (DBE, 2011a). Mr. P, however, relied on giving explanations and examples as schemas in his teaching.

Moreover, he repeatedly wrote all of the concepts, which were under the topic of the Earth spheres. Mr. P also discussed those concepts by writing on the board with the learners. There were instances wherein he was asking his learners to name the types of gases. However, he did not bring any model with him to the classroom to demonstrate the content to the learners. Furthermore, Mr. P used a traditional teacher-centered approach in his teaching throughout the lessons.

Mr. P did not use active learning strategies, which are learner-focused and supposed to be eminent in a science classroom. In many instances, he recited or spoke aloud about the concepts in his teaching. He preferred this traditional approach because he was trained at college with this traditional approach and believed that it was the best teaching method. However, Kaddoura (2011, p. 4) indicates that the traditional approach could lead learners to become "shallow, surface thinkers" who depend on memorization instead of a meaningful understanding of the content. Furthermore, the learners can suffer from a deficiency of higher order skills. Mr. P`s lesson also did not accommodate Problem-Based Learning (PBL) as he did not provide tasks or activities. Adopting the constructivism approach, PBL encourages teamwork and allows learners to gain cross-curriculum skills (Hopper, 2014). Moreover, PBL creates room for collaboration among learners, which was not seen in Mr. P`s classroom. Although he was willing to put learners in groups before the lessons, he did not place learners in groups during the lessons.

As a result, learners had to rely on Mr. P's traditional rote teaching; hence, they suffered from a lack of social interactions in the classroom. Moreover, Mr. P did not provide learning differentiation for different types of learners since he did not use various teaching strategies and utilized only one strategy, traditional teaching (Rankhumise, 2018). Employing differentiation strategies could allow the teacher to have a proper and imperative lesson planning to address learners` diverse needs. The use of differentiation strategies can result in achieving specific goals (Bennett, 2007), which were the three specific aims in this case (DBE, 2011a). As stated in the related literature, when teachers do not provide room for learners to address their individual style of learning in the classroom, they fail to progress (Bennett, 2007).

Although Mr. P indicated his intent to use dialogic discourse over authoritative discourse, Mr. P`s teaching was generally dominated by the authoritative approach of teaching. He was transmitting definite details of the content to the obedient acceptors, who were learners in this case.

Mr. P: Which amongst those gases is having more percentage than other gases? You can raise your hands. (Within 3 seconds when no learner responded, he was quickly back to teaching and wrote on the board while reciting)

Mr. P also used question and answer techniques when he was facilitating his lesson. He asked questions to trigger learners` thinking and opinions, consequently forming

correlations between different ideas . Doing so made his articulation in class partially dialogic but was dominantly authoritative due to his usage of the lecture method. As a result, there was no direction approach of learning Mr. P used in his teaching. The communication in class was non-interactive/authoritative (Scott, Mortimer & Aguiar, 2006). This was due to the fact that there was communication between Mr. P and the learner/s, but Mr. P was the dominant voice in his class, choosing the authoritative approach. Mr. P began the lesson by asking questions to learners to test their prior knowledge but gave them minimal chance to respond and interact with him since he kept on feeding them with more information. The pattern of discourse that he applied in his class was initiation , response and feedback (Graesser, Gernsbacher & Goldman, 2003). For example, Mr. P initiated the concept of the lesson in the following way: He wrote a question on the board about the shape of the Earth. He sustained his question by asking about the shape as "how is the Earth?" One learner raised her hand and said that it was roundish.

It can be summed up that Mr. P`s lesson was dominated by a lot of content at once, which was beyond and outside the NS curriculum. Furthermore, Mr. P was directionless in his articulation. He would move from one point of the lesson to another and then ultimately come back to the original point. Mr. P utilized and relied on one learning strategy, the lecture method. Science is dominated by its practicality; hence it is a doing subject. That was, however, not evident in Mr. P`s class as learners had to rely on his directives. Learners learned individually and had limited engagement with their peers. Mr. P indicated a lot of disregard and failure to recognize the CAPS document as the navigator of his teaching. He relied on what he believed should be taught rather than what should be taught as it appears in the policy document (DBE, 2011a), hence showing poor SMK (Rohaan et al., 2012). As a result, he provided learners with knowledge from a general view of the content rather than from a specific point. Despite the NS curriculum policy document indicating active and critical learning as one of its principles, Mr. P chose the opposite route, implementing rote learning in his classroom.

Case 2: Mr. JB

Mr. JB indicated his awareness on what content is to be taught in his class hence showed sufficient SMK (Rohaan et al., 2012). For example;

Mr. JB: So when we say the Earth, we are not talking about the soil. We are not talking about the trees. We are not talking about the water. However, we are talking about different things, which are working together to bring one thing we refer to as the Earth. Therefore, in short, I can say the Earth consists of systems, which are water, air, the soil. These things work together to support each other to sustain life.

Despite the good content knowledge and adequate SMK that was evident in Mr. JB`s classroom, the same cannot be said about the prior knowledge that he revisited. The CAPS document (DBE, 2011a) required teachers to revisit the content of concentric layers of the Earth from grade 7 Social Sciences. However, Mr. JB chose to revisit the content from grade 8. Even though it was not entirely irrelevant, the provided prior knowledge did not build up to new emerging knowledge (Messa et al., 2014).

Moreover, Mr. JB showed his awareness of the importance of prior knowledge when he indicated that learners should develop new knowledge from their background knowledge. Hence, he provided a task to learners. However, the questions asked from the task contained main themes of the lesson. Thus, the questions were not specific themes to elicit prior knowledge. Moreover, some learners demonstrated misconceptions.

Mr. JB utilized learner-centered instructional strategies. He allowed learners to work in groups in their learning, allowing collaboration among them (Arends, 2012). Mr. JB

indicated that he initiated group learning because he believed that learners should learn from one another. Moreover, the collaboration had a good effect on learning as some tasks might prove difficult to some learner while easy to others, so having learners working in groups allowed them to have alternative paths for inquiry and discussion, and increased their motivation (Arends, 2012). Conklin (2007, p. 5) indicates instructional strategies as those "needed by teachers to enhance learning for diverse learners." However, an educator should not rely on one strategy when going to class (Halai & Khan, 2011). Consequently, Mr. JB utilized both collaborative learning and classroom discussion in his class by accommodating individual learning differences. Mr. JB used analogies in his classroom to explain different concepts. The use of analogies helped to indicate variations and similarities between two diagrams presented on the board. Doing so allowed learners to draw, label, write, model, investigate, discuss, name, sequence, dissect, and research (DBE, 2011a).

This approach by Mr. JB helped learners in creating a clear picture of how the three spheres (i.e., the lithosphere, the atmosphere, and the hydrosphere) interact with one another and the biosphere.

Classroom discourse is the diverse engagement that takes place between the teacher and learner/s. As Mr. JB indicated during the interviews and seen in classroom observations, Mr. JB highly characterized his lessons with dialogic discourse. In doing so, Mr. JB asked questions to trigger learners` thinking and opinions, forming correlations between them. Mr. JB believed that allowing learners to engage with him and among themselves allowed them to learn from one another rather than learning from a book alone. As such, his class was predominantly dialogic/interactive. According to Scott et al. (2006), the communicative approach focuses on how a teacher communicates with the learners. Moreover, if effective, the communicative approach can establish opinions and awareness of learners which relies directly on social coherence (Belik & Yarden, 2016). Likewise, Graesser et al. (2003) recognize the initiation, learner's response, and teacher`s feedback as patterns of discourse in class, which were evident in Mr. JB`s class. In this context, firstly, the teacher initiates communication by probing a question to learners, the learner then responds to the question, and the teacher finally gives feedback in the process (Molinari et al., 2013).

It can be summed up that Mr. JB was at a particular stage found to be talking about the content, which was not part of the topic, spheres of the Earth. He was found to be teaching about the composition and abundance of Nitrogen in the atmosphere. This was a downside in his teaching since the content belonged to the incoming topic, the atmosphere, which is the last topic of the PEB stand for grade 9 (DBE, 2011a). Consequently, learners received a lot of content at once, which ultimately may result in misconceptions and misunderstanding.

Mr. JB displayed great awareness of the principles and aims of the science curriculum as he used methods that seek to achieve active and critical learning instead of rote and other traditional teaching methods (DBE, 2011a). That was easily achieved by his usage of discussion and collaborative learning method wherein he paired learners and encouraged them to work together on given problems. As such, he initiated the PBL approach, which allows learners to investigate authentic tasks, support teamwork, and improve relevant curriculum skills (Hopper, 2014). He also employed great analogies where he illustrated accurately through drawings how the three spheres (i.e., the lithosphere, the atmosphere, and the hydrosphere) interact with one another and with the biosphere (Criticos et al., 2012).

Mr. JB generally used a learner centered approach. However, on particular occasions, he did not allow learners to lead their learning. After learners drew two different interaction

of spheres diagrams on the board, it was expected that he would lead learning in such a way that would allow them to spot the differences and similarities in the diagram. However, learners could not receive the opportunity to extrapolate information themselves. Consequently, this approach did not accommodate skills such as analysis and application, which could result in leaners becoming "shallow, surface thinkers" who depend on memorizing instead of properly understanding the content (Kaddoura, 2011, p. 4). Moreover, the NS CAPS curriculum encourages learning to be active and critical, something Mr. JB should have taken into consideration.

CONCLUSION

In this study, findings revealed that participating NS teachers (i.e., Mr. P and Mr. JB) carried misconceptions to their classrooms and added some other misconceptions by teaching irrelevant content. This indicated that the teachers possessed poor SMK. One of the teacher`s content knowledge teaching was disorganized and lacked direction as he moved back and forth in his articulation. Both teachers' contextual knowledge did not assist them in articulating their subject matter. For instance, the spheres of the Earth topic, which could have been taught effectively outdoors and/or in the laboratory was taught in the classroom with insufficient teaching aids. Further to that, teachers in the study had little knowledge on specific aims and assessment strategies to be employed in an NS class. Moreover, the results of this study revealed that teachers had difficulties in choosing the appropriate instructional strategies, which should have included active learning and constructivism. Additionally, teachers saw themselves as the authorities in class and hence applied a one-way approach, which stands in the way of collaborative learning and engagement. In general, the participants showed a lack of adequate SMK to teach the strand planet Earth and beyond, even though they were adequately qualified and had appropriate teaching experience.

Suggestions

It is suggested that the SMK with particular reference to the strand planet Earth and beyond should be enhanced. There have been efforts to improve the SMK, but this study showed that these efforts have yet yielded the desired results. The authors of this study recommend authentic discussions on the subject matter be held at cluster level such that colleagues can be free to articulate their challenges and difficulties for pre-service teachers before their actual classroom experiences. It should also be noted that the instructional strategies which colleagues adopted does not promote meaningful teaching and learning processes. Thus, the authors encourage teachers to have discussions on the appropriate and best instructional strategies to use based on their contexts. It should also be acknowledged that the number of participants in this study was limited. Therefore, it is recommended to conduct larger scale studies about NS teachers' experiences on the teaching of planet earth and beyond knowledge strand.

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