EXPLORING GRADE 7 NATURAL SCIENCES TEACHERS' VIEWS ABOUT NATURE OF INDIGENOUS KNOWLEDGE AND HOW THEIR VIEWS INFLUENCE THEIR CLASSROOM PRACTICE

By

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LIST OF ABBREVIATIONS

NOIK : Nature of Indigenous Knowledge
NOS : Nature of Science
IK : Indigenous Knowledge
ST : Standpoint theory
NCS : National Curriculum Statement
CAPS : Curriculum and Assessment Policy Statement
DBE : Department of Basic Education
IK : Indigenous Knowledge Systems
NS : Natural Sciences
VNOIK : Views about Nature of Indigenous Knowledge
SSI : Semi-structured interviews

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SIGNATURE 

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ABSTRACT

Understanding the Nature of Indigenous Knowledge (NOIK) which embodies Indigenous Knowledge (IK) has the potential to play a pivotal role in the classroom and in our societies. South Africa has made it compulsory to integrate IK in Natural Sciences (NS) classroom practice, as per CAPS document. However, there is a general lack of research on NS teachers' views on NOIK. As a consequence, this study explored NS teachers' views on NOIK and how these views influence their classroom practice.

This study used Standpoint Theory (ST) as a theoretical framework, and employed the multiple case study design where six cases were explored. In addition, the study adopted the qualitative research approach, which depended on the Stake multiple case study design. The six cases represented were six NS teachers from Dimamo Circuit, and each teacher acted as a case. Each teacher filled in the VNOIK open-ended questionnaire, observed twice, and a semi-structured interview was

administered. Direct Interpretation together with thematic content analysis were employed to analyse the data.

The findings showed that majority of NS teachers hold informed views on NOIK, whilst others hold Partially Informed views. Furthermore, majority of NS teachers did not include all aspects (tenets) of NOIK in their classroom practice. However, they were mostly satisfied with the lessons they had. Although the results from VNOIK questionnaire showed that NS teachers appear to have informed views on NOIK, these findings suggest that the teachers still need to integrate NOIK in their classroom practice. Lack of NS teachers' ability to integrate IK in their classrooms made it impossible for the researcher to determine how NS teachers' views on NOIK influence their classroom practice.

Keywords: Nature of Indigenous Knowledge, Indigenous Knowledge, Standpoint theory, Nature of Science

Chapter 1: Foundation and way to the study

1.1 Introduction

This chapter outlines the main attributes that channeled the researcher to carry out this study. It outlines the main reasons why the researcher decided to explore mainly grade 7 Natural Sciences teachers' views on NOIK and how these views influence their practice. The interest was mostly gathered on the topic, Nature of Indigenous Knowledge (NOIK), which is the most research topic in recent literature.

1.2 Background and motivation

After some countries became independent in the past years, one of the immediate tasks of governments was to address the diverse cultures in classrooms (IN & Van Rensburg, 2009). Studies have shown that understanding the Nature of Indigenous Knowledge (NOIK), which embodies Indigenous Knowledge (IK), has the potential to play a pivotal part in the classroom and in our societies (Bailey *et al.,* 2019; Msimanga & Shizha, 2014). NOIK is referred to as cultural philosophies that were developed by societies based on historical interactions with their environment (Battiste, 2002; Ezeanya-Esiobu, 2019). These cultural philosophies have the potential to build a body of knowledge, including Indigenous Knowledge System (IKS). IKS is defined as a knowledge body that is entrenched in social practice and philosophical thinking that has been passed from one generation to the other over million years (Absolon, 2022; Le Grange, 2011). Contagiously, every learner comes into the classroom with their own NOIK. Natural Sciences educators must familiarise themselves with the context within which their learners are operating in, so that they are able to understand their interpretations of knowledge that they will receive in the learning process (Mavuru & Ramnarain, 2018).

Just like every learner coming into the classroom with their own NOIK, NS teachers also hold their own NOIK to carry out their practice (Ogunniyi, 2007). The same NOIK these teachers bring into NS classrooms is the body of knowledge that has been formed from the society within which they (NS teachers)

come from (Baskin, 2022). Society forms critical aspects that shape individuals, including NS teachers. So, our environments affect us in terms of our culture, behaviour, attitudes and mostly the baseline knowledge we carry throughout our entire life (Glenn, 2004). Hence, the same knowledge we use throughout our life is intended to be integrated with other bodies of knowledge like western scientific knowledge. Some studies argued that teachers come into the classroom with their own NOIK (Ogunniyi, 2007). This made it easier for this study to consider NOIK in terms of NS teachers' views about it (NOIK) and how these views influence their practice. Thus, it is again in line to question the relevance of the topic in relation to our curriculum in South Africa.

The implementation of the Curriculum and Assessment Policy Statement (CAPS) on NS through amendments of the past curricular is more precise on the specific aims that NOIK and IK must be included and incorporated when teaching Natural Sciences (Jacobs, 2015). The modern curriculum, CAPS stipulates that learners should also be overtly drawn to the Nature of Science (NOS) ideas by teachers who are knowledgeable about NOIK and are able to incorporate IK in their pedagogy in a way that allows them (learners) to engage in culturally related content in Science (Seehawer, 2018). NOS and NOIK correlate on the instance of nature being real and observation as tenets (Cronje, De Beer & Ankiewiczs, 2015). Thus, calls for teachers who are knowledgeable about NOIK to integrate learners' NOIK with the Science being learnt in the classroom in order to acquire adequate knowledge at the end. Furthermore, the knowledge reflected by the learners in their NS classrooms should demonstrate the integration of IK by the teachers in their pedagogies (DBE, 2011; Clough, 2018). The demonstration would be a sign that they are successful in integrating IK, as such they are knowledgeable about NOIK. The success enabled learners to use scientific knowledge they gained when they make decisions on both every day and socio-scientific subject (Brits *et al*., 2016).

South Africa, including other nations in Africa, has rich artifacts that are related to Science in their cultural environment (De Beer & Mothwa, 2013). These artifacts are the core aspects in supporting the integration of IK in Science in South Africa. Henceforth, IK integration in South Africa (NS) in the lower grades is possible.

The call for the use of these artifacts has grown from the past two decades, from the curricular implemented by local and international researchers (Chapman & Schott, 2020). Although most researchers have stressed the integration of IK over Life or Physical Sciences, the study was conducted on NS with the help of knowledge gained from cultural backgrounds and teachers' knowledge about NOIK. Therefore, this study explored NS teachers' views (NOIK) and how these views influenced their teaching.

1.3 Research problem

The National Curriculum Statement (NCS) and CAPS for NS confirm and affirm that Indigenous Knowledge System (IKS) and the integration of IK is of paramount significance in Science education (Jacobs, 2015). Ideally, NS teachers who integrate IK should be knowledgeable about NOIK and be able to include it in their practice. The integration of IK may positively impact learners and educators as they embark on NS education by acquiring scientific knowledge and skills. The impact is greater if the teacher has rich NOIK (Seehawer, 2018). In addition, adequate integration of IK offers learners a better starting point to learning about the world of Science (DBE, 2012; De Beer & Mothwa, 2013). Accordingly, NS teachers should integrate IK within the parameters enshrined in the NS CAPS document, which recognises and affirms that IK is important in the process of Science pedagogy (DBE, 2011).

In essence, the literature suggests that most researchers focused their studies in NOIK and the integration of IK on Life and Physical Sciences curricula as opposed to the NS curriculum (Mothwa, 2011; Jacobs, 2015; Seehawer; 2018). In addition, most NS educators lack exposure regarding IK experiences; rather these educators were exposed to scientific knowledge of the west (De Beer & Kriek, 2018). This brings forth the argument about whether NS teachers are knowledgeable about NOIK and can integrate IK in their pedagogy (Hewson *et al*., 2009); hence, raising interrogations about teachers' views on NOIK and their ability to integrate IK in their classroom. A lack of research regarding NS teachers' views on NOIK and about how they integrate IK in their teaching may hinder opportunities for learners to have a better solid admission to Science.

Thus, this current research study seeks to explore grade 7 NS teachers' views on NOIK and how these views influence their practice.

1.4 Purpose of the study and research questions

1.4.1 Purpose of the study

The current study seeks to explore Natural Sciences teachers' views on NOIK and how these views influence their teaching.

1.4.2 Research questions

- What are Natural Sciences teachers' views on NOIK?
- How do Natural Sciences teachers' views on NOIK influence their classroom practice?

1.4 Key Definitions of the study

This study will consistently use the following key definitions.

Nature of Indigenous Knowledge - is referred to as cultural philosophies that were developed by societies based on historical interactions with their environment (Battiste, 2002; Moulaison & Bossaller, 2017).

Indigenous Knowledge - philosophical thinking that has been passed on from one generation to the other over million years (Le Grange, 2007). It is referred to as a specific form of knowledge that is local, specific to place and could be synonymous to ways of knowing (Khupe, 2014).

Western Knowledge/ Science- body of knowledge that is in relation or indicates relation with western societies (Mazzocchi, 2018; Sillitoe, 2017; Sutherland, 2016).

Indigenous Knowledge System- Knowledge system held by different indigenous groups often termed as Traditional knowledge (Chapman & Schott, 2020).

Standpoint Theory – is referred to as a human theory that consists of three worlds that shape an individual's Indigenous Knowledge (Foley, 2003).

Practice – is referred to as an educational practice that consists of activities and judgements that are more based on theoretical principles and rooted in philosophical ethnicities (Carr, 1987).

Nature of Science – refers to epistemology of Science as a way of knowing, or beliefs and values as inherent to the establishment of scientific knowledge (Lederman, 1992; Okan & Kaya, 2022).

Curriculum and Assessment Policy Statement – curriculum in South Africa that is based on the revision of the National Curriculum Statement (Ndou, 2022; Manik, 2022).

National Curriculum Statement – South African past curriculum that was on Grade R-12 that gave expression to the knowledge and values that were worth learning in South African schools (Rusznyak, 2020).

Department of Basic Education – Ministerial branch that is responsible for making educational policies and programmes to ensure access to quality basic education (South Africa (SA), 2011; Charton, 2014).

Indigenous Knowledge System – system of knowledge that was acquired over years by generations and generations in a community (Latulippe & Klenk, 2020).

Natural Sciences – is a group of disciplines that deals with the physical world in phenomena occurring in nature (Tikhonov, 2020).

Views on Nature of Indigenous Knowledge – Research instrument that is based on figuring out teachers' views on the Nature of Indigenous Knowledge **(**Ngcobo & Mavuru, 2020**).**

Semi-Structured Interviews – a type of interview where there is a verbal interchange where the interviewer asks open-ended questions based on an assigned topic framework (Adeoye-Olatunde & Olenik, 2021).

Observation – Is a research method or technique that is used to study participants' behaviour in their own natural setting or environment (Alam, 2021).

1.5 Research design outline

The study rested upon the use of a case study, where it treated six individual cases. The results of the use of IK came as a result of a multiple case study design by Stake (1995), who defines it as a design whose purpose is to allow the researcher to treat multiple cases under a single study. The researcher further used an exploratory case study, which allowed him to conduct the study in the interest of researching about a problem that is not well defined (Pan & Scarbrough, 1999). Moreover, the use of the design allowed the researcher to add to the literature across the field of NS discipline.

Under the study, six cases of NS teachers were treated with the use of three instruments, namely, VNOIK questionnaire, observation schedule and SSI. The ideal is that the cases are empirical wherein observations are vital and interpretive where the subject and the researcher interact. The multiple case study design was deemed suitable for the study as it allowed one to have multiple subjects acting as a cases, while at the same time allowing the researcher to have his own integral system (Stake, 2000).

1.6 The study report plan

In chapter 1, the introduction and background section outlined the reasons why the researcher embarked on this study. The outline was backed by the inclusion of literature, which extended towards the problem statement that clearly outlined the main problem in detail. The problem was clearly defined to give the true highlights of what the literature says against the reality in NS discipline. The outline led to insights into why the study should be carried out. To further elaborate on the problem, chapter 1 gave the research questions, the purpose and significance of the study. In summary, chapter 1 was more likely interested in defining the problem with the help of literature, which leads to motivations on the background and the formulation of research questions.

Chapter 1 came into play as the detailed literature of the study. The introduction was then made followed by the contents on the need to integrate IK. The underlying reasons about why IK should be integrated were stipulated, among which is the fact that IK is of paramount significance just like the other body of knowledge. The

exclusion of NOIK and its inclusion in the recent curriculum was then elaborated. The elaboration included the exclusion of NOIK in different environments in South Africa and across the globe. The inclusion is based on the contemporary curriculum. The study went on to give the background of Theory used, namely, ST and elaborated on its three tenets. This was followed by discussions of NOIK and NOS in NS classroom. The reason for the discussion of NOS was because there is lack of literature on NS teachers' views on NOIK as opposed to their views about NOS. The researcher further elaborated on how the two were viewed in the study. The chapter concluded by looking at the need to integrate IK by a teacher who is knowledgeable or hold a view about NOIK.

Chapter 3 aligned the methodology of the study. The methodology was more interested in how the study is going to respond to research questions. In elaboration, the chapter explained the research paradigm, design, and sampling as well as how data was collected and analysed. It then concluded with the ethical considerations of the study, where it was explained how the study is going to treat the participants.

Chapter 4 presents the data collected by the researcher and the results. The six cases data on VNOIK questionnaire, observation schedule and SSI were presented. This was followed by discussions under each presentation. This chapter, excluding anticipated raw data, gave the biographical information of the participants. All six cases were presented in a similar structure.

Chapter 5, which is the last chapter of the study, gives the summary of the presented data and draws conclusions based on that summary. Furthermore, recommendations as well as the limitations of the study were suggested.

1.7 Significance of the study

The vital role of this research study is that it will expand the existing body of knowledge about IK and benefit researchers, teachers, and learners. This is because Indigenous Knowledge is sometimes ignored or even refuted and may be seen to be at odds with scientific knowledge (Baquete *et al.,* 2016:2). Kibirige and Van Rooyen (2006) and Arday *et al.* (2021) state that IK has been neglected for many years. This study will contribute towards the body of scholarship. This will enable incoming

researchers to have adequate literature within the field of IK based on discussion at the problem statement of this study that teachers have difficulties in integrating IK. The findings and recommendations of the study will help them to understand, build knowledge economy, review their pedagogical content and structure how to integrate IK in the classroom. Furthermore, it will give them freedom to put their views on how they understand NOIK in a way that clarifies their own misconceptions and preconceptions. Learners will benefit from the learning process and will be free to express their personal knowledge on IK and gain proper prior knowledge in the learning of Science.

This study is aimed at bringing to light new knowledge about views that NS teachers hold about NOIK and how these views influence the way they teach mainly in their practice. The study will also contribute to awareness to NS teachers in senior phase and other phases about the importance of integrating IK. The awareness will extend to NS curriculum advisors if the need for the development of NS educators arise.

1.8 Conclusion

The chapter has presented the main reasons why the researcher decided to embark on the study. The chapter was made through the outline of NOIK and its integration, followed by the researcher stating the ideal about the integration of IK in classrooms. This was followed by reality, which led to the action that is to be taken. The researcher further elaborated by giving the purpose, questions, the significance, and the impact of the study in society.

Chapter 2: Literature Review

2.1 Introduction

The main purpose of the study is to explore grade 7 NS teachers' views on the Nature of Indigenous Knowledge (NOIK) and how these views influence their practice. NOIK is one of the largest bodies of knowledge consisting of tenets where most of them are collinear with those of the Nature of Science (NOS) (Cronje, De Beer & Ankiewiczs, 2015). NOIK is referred to as the epistemology of Indigenous Knowledge, and outside the classroom, it is referred to as cultural philosophies developed over the years on each community or group of people, which eventually results in Indigenous Knowledge System (IKS) (Zinyeka *et al.,* 2016, p.40). IKS is built in Indigenous Knowledge by practicing some cultural philosophies (Battiste, 2002). The IKS embeds Indigenous Knowledge (Pophiwa & Saidi, 2022). Considering this, NOIK is the formation of cultural philosophies across individuals in each ethnic group. It is then important to study it in order to preserve the knowledge for future generations (Owolabi *et al.*, 2022). Individuals, including learners and teachers, are from different ethnic groups. This means that they come in the classroom having their own IK (Zidny *et al.,* 2020). Thus, the inclusion of NOIK is required in the classroom, where it is integrated with western knowledge, hence, gearing up this study to explore if NS teachers' views on NOIK are more adequate or not and further explore those views against teachers' practice.

This chapter then strives to expand more on NOIK exclusion and inclusion. The chapter stresses the need to integrate IK with knowledge learnt in NS classrooms, how it has been integrated and how it is contemporarily integrated. The study dwelled also on historic IK, both in the classroom and across the world to compare them with contemporary IK. This includes how NOIK was excluded or included in the past decades across the world or classrooms in the African continent and the South African programme of study, Curriculum and Assessment Policy Statement (CAPS). The theoretical framework was also aligned with the literature to establish and channel the research and its range to where the data should be limited.

The key constructs channeled out by the Theory was also outlined in detail, including the definitions and its relation to the current study. The key constructs on the title are NOIK, views and practice. The researcher has outlined what NOIK is all about and related it to the study. In addition, the views and practice were also defined in terms of teaching and were related to the study.

2.2 Need to Integrate Bodies of Knowledge

In every society, there are different converging worldviews (Halloun, 2020). A practical example can be learners' Indigenous Knowledge and their scientific knowledge in the classroom (Le Grange, 2007). The two worldviews need to be integrated, if not well integrated, learners' Science learning process may be compromised, and this in turn, may result in a cognitive conflict (Persson & Johansson, 2018). There have always been two knowledge bodies involved in NS classroom: Eurocentric and IK. Although Eurocentric knowledge is the dominant one, IK also exists (Botha, 2012). The convergence of the two knowledge bodies should be channeled by the NS teacher who is knowledgeable about NOIK (Hewson *et al*., 2009; Hunter, 2015). The only teacher who can integrate IK in the classroom is the one who holds a view about NOIK (Cronje *et al.,* 2015), meaning there is no integration of IK in NS classroom without the assistance of the NS teacher who holds a view about NOIK.

It is important to integrate IK in the NS classroom as a body of knowledge (Bailey *et al.,* 2019). There is a disregard of IK in the classroom (Dlamini & Ndzinisa, 2020). The discontent came about when people across communities do not believe that IK plays a role in the classroom. Most communities hold the notion that it does not contribute towards scientific knowledge development or NS teaching (Dawson, 2019). This could be caused by the IKS that was built upon the circumstances of the previous education curriculum that was passed to generations upfront (Jacobs, 2015). This could have installed fear to exercise the integration of IK in the teachers' practice. More will be discussed on exclusion of IK about past teachers' practice. Hence, the integration of bodies of knowledge is vital as a way of giving equal opportunities between the bodies of knowledge and to restore integrity and pride among all NS teachers and learners. This will in turn contribute to the bodies of knowledge.

2.3 South African Native Indigenous Knowledge and Western Science

It is a written fact that several scientific bodies and progressive interventions have called indigenous or traditional body of knowledge or system to be recognised as a well-respected and valuable body in African Science (Hill *et al.,* 2020). Thus, provoking, and questioning teachers' views on NOIK is important in order to enforce the recognition of Indigenous Knowledge in NS classrooms (Cronje *et al*., 2015). All the concerned parties about the recognition of IK in the classroom come after looking and analysing statistics about it (Jacobs, 2015). The lack of recognition of IK in the early Science (NS) has proven to be misleading our learners in the other Science disciplines (Life Sciences and Physical Sciences) (Bozhkov *et al.,* 2020). CAPS as a curriculum in South Africa highlights the recognition and inclusion of learners' traditional Knowledge on its introduction to the NS curriculum (DBE, 2011). In addition, the CAPS also highlights specific aim number three, which states that learners should understand the use of NS and IK in the society and environment.

Western Science, on the other hand, was initially and contemporarily recognised and included in all Science classrooms (Kadykalo *et al.,* 2021). According to Wallace (1996), western Science is an enquiry in Science that is done in Greek, Latin or Arabic. The statement articulates that western Science was mainly established based on Greek, Latin or Arabic personal or Indigenous Knowledge, which was then proved using scientific enquiries or processes and investigations (Khupe, 2014). African IK constitutes and focuses on dimensions, spirituality, local knowledge, and values (Ludwig, 2016) and is often passed on orally from one generation to the next by the elders (Masoga, 2020). This constitutes another cause why African IK could not fit abundantly on the scientific enquiry like western knowledge.

2.4 Impact of a teacher who is knowledgeable about NOIK in the NS classroom

A teacher who is knowledgeable in NOIK will be able to check and integrate relevant knowledge that is required to be contextualised with the content being taught (Hunter, 2015). Moreover, the procedure of demonstration and explanations will show how knowledgeable the teacher is. Similarly, an NS teacher who is knowledgeable in NOIK can integrate IK in their practice. The teacher's ability to

demonstrate and put explanations accordingly compensate helpfully towards learners' thinking about IK topics in NS (Jan, 2017). Again, learners' way of thinking is redirected in a way towards better focus during the learning process.

As much as learners benefit through a teacher who is knowledgeable in NOIK, the teacher also benefits in return (Magni, 2017). He can regain the whole class-consciousness or wittiness; knowing the needs and wants of the learners involved in his practice and channeling the learners' behaviour during the practice (Conrad, 2022). Through class-consciousness, NS teachers can be able to accommodate all learners; and above all, preserve and practice Indigenous Knowledge in the education system (Owolabi *et al*., 2022; Hu *et al*., 2023).

2.5 Exclusion of IK in Africa and world

Exclusion of IK in the rest of the world means that indigenous peoples' equity, fairness, and culture are excluded from the world's dialogue (Mji *et al*., 2020). There are indigenous people in the world, which spreads across 90 countries. Indigenous people like Aboriginals in Australia, Adivasi in India and Métis in America, including others around the world have been living under exclusion in the past years (Egan, 2021). Moreover, their Indigenous Knowledge was not documented in a way of preserving it. In Southern Africa, the culture of the Khoisan as indigenous people of the land was never documented or taught formally in schools (Verbuyst, 2022). The Indigenous Knowledge of the Bantu people, who spread in Africa has also been neglected and purposely left out (Gallo, 2020). The main cause was the colonial effect of the education system. Most countries were forced to learn colonial language instead of their own native languages.

The colonial impact across Africa made Africans to learn Science as per western Science basis (Atauhene, 2011), influencing their beliefs over the years about Science that they have been practicing over the years from generation to generation. The barrier then was formed on Indigenous Knowledge dissemination (Khupe, 2014). NOIK was then faced off in Science classrooms in the understanding that western Science should be the main Science in the classroom (Verbuyst, 2022). This resulted in indigenous learners and teachers to not fully participate in the system. This may have affected the generations that followed.

Western Science devalued most countries' local or indigenous Science practice regarding them as primitive or too local to be followed (Jacobs, 2015). Furthermore, learners were led or taught to believe that they are inferior on the basis of their culture. Local Science was regarded and deemed as common sense which cannot be proven (Hunter, 2015). This means that native learners were unable to reason based on their 'common sense'. NS teachers and learners' reasoning was guided by the colonial-mid class mainstream explanations on phenomena (Jacobs, 2015). It is evident that Indigenous Knowledge at schools is silent and dominated while western knowledge is continuously visible in schools and communities (Van Rooyen, 2015).

2.6 Exclusion of Indigenous Knowledge in South African NS

South African Indigenous Knowledge is abundant. This is recognisable since South Africa is a multi-cultural country (Raseroka, 2008) in a multicultural continent, Africa. It has been found that sections of countries' IK have been neglected in the past years due to the post-apartheid era, more specifically in Natural Sciences Education (DBE, 2012; Kibirige & Van Rooyen, 2006; Nel, 2005; Reddy, 2019).

The South African curriculum CAPS on NS (DBE, 2011) states that IK should be included in grade 7 NS practice. The only predicament is that the curriculum does not show how it should be implemented (Reddy, 2019). This lack of instructions on how to implement the integration of IK further causes and rises interrogations if NS teachers are given opportunities to integrate IK in their practice; hence, questioning their views on NOIK. If they do integrate, perhaps unaware, do they know if they are including NOIK in their NS classroom? Furthermore, the researcher can interrogate if they are knowledgeable about NOIK. In blindfold, the integration of IK might have been included in writing on the document but not practiced based on the reasons above.

Ancient people around the world have maintained their unique culture or IK for a couple of eras (Barnhart & Laporte, 2007; Fletcher *et al.,* 2021). IK has been there across the world, including in South Africa for many centuries. The only hindrance is that it was ignored from the scientific world for decades, causing a lack of understanding if NS teachers are knowledgeable in NOIK and can integrate IK in the

classroom (Kibirige & Van Rooyen, 2006). The omission of IK for centuries has been attributed to the fact that it lacked native literature and books that supported its foundation (De Beer & Whitlock, 2009; De Beer & Van Wyk, 2011). The omission and negligence of IK in past curricula in South Africa is classified as the knowledge fault that was altered during the apartheid era (Regmi & Fleming, 2012). Knowledge of native people was neglected and omitted in the curricula (DBE, 2012). This was because native people were oppressed, more especially about their Indigenous Knowledge (Khupe, 2014).

2.7 Indigenous Knowledge revisited

Over the past three decades, NS educators have shown increasing interest in indigenous and neo-indigenous ways of knowing about nature, which includes NOIK (Aikenhead & Ogawa, 2007; De Beer & Kriek, 2021). This was empowered by the need to attain social justice in societies and Science education (Magni, 2017). The interest was again intrigued by many other intrinsic motives. Scholars in Science wanted to expand the literature from existing literature for better understanding of NOIK in Science education (Zidny *et al*., 2020). All these major motives were fueled by movement that has set as its goal to provide enhanced sovereignty of IK across the world. The major motive was set to rebuild and reconstruct nations' indigenous ways (McKinley, 2007).

On the other hand, the increase interest in revisiting NOIK collided with the survey that shows that teachers want to understand the influence of indigenous ways in the Science classroom (Twikirize & Spitzer, 2019). The interest survey includes incoming teachers in NS discipline. The concern to revisit IK was facilitated by the desire to attain fairness to all the societies to ensure that mathematics and Science flourish in schools. The increased interest indicates that NOIK is important in Science education, which includes early Science (NS). The revisitation again allows the current researcher to question the ideas and views of NS teachers about NOIK.

2.8 Inclusion of IK and NS teachers' views on NOIK currently

It is a condition set by CAPS that IK should be integrated with the knowledge taught in NS classroom to accommodate all learners (Ogunniyi, 2007; DBE, 2011; Persson,

2018). South African schools are rich in cultural diversity and biodiversity, which can offer wonderful learning opportunities for learners (Shizha, 2013). Some of the opportunities include deep learning, confidence, and growth, to name few. NS teachers' views on NOIK in NS curriculum are important (Ogunniyi, 2007; Skinnari & Bovellan, 2016). The teachers' views are so significant that they should make sure that all learners are accommodated by the teacher during the lesson. The teachers' views can either be for progression or a barrier to learning (Cronje *et al.,* 2015). The main progression among all is that learners who are taught by a teacher who hold a better view about NOIK in an NS classroom can gain a better view of the scientific world (Kibirige & Van Rooyen, 2006).

The inclusion of integration of IK by teachers who hold a better view about NOIK can eradicate some of the major economic issues (Van Wyk & De Beer, 2012; Šūmane *et al*., 2018). The knowledge that teachers can impose on learners as required by CAPS can eradicate issues like food security and lack of proper health care, more specifically in rural villages (DBE, 2012; Šūmane *et al*., 2018). The eradication will show how the relevant integration of IK and teachers' views are to our daily lives. Once the eradication is done, new opportunities kick in. Some of the new opportunities include the creation of jobs and the enhancement of learners' entrepreneurial skills. For example, pupils in Giyani learnt and discovered an insect repellent plant *Lippia Javanica*, which was later clinically proven to be an insect repellent. This brought the stigma of job employment and entrepreneurial skills to the public (De Beer, 2016).

2.9 Theoretical framework Standpoint Theory (ST)

In every Science classroom, there are indigenous learners who require the integration of IK by the teacher who is knowledgeable about NOIK (Butler, 2009). Theory underpinning this study is the Standpoint Theory (ST). Theory stipulates that every learner and teacher come into class having been influenced by the physical, human, and sacred world as its tenets (Rigney, 2017). All the three worlds influence the views of teachers about NOIK (Foley, 2006). Furthermore, they also influence the type of knowledge that one gains. The physical world is part of an environment where one grows in. Here, the knowledge gained can be shaped by the environment where one grows in and encapsulates the land, the sky and living organisms (Foley,

2003). This is based on the land which is our food, culture, spirit and identity. So, the knowledge that one gains is likely to be shaped by the environment that one comes from (Foley, 2006). The human world expresses the knowledge gained through human interactions with one another on the environment, while the sacred world is more about the metaphysical world but not entirely (Rigney, 2017). It explains one's knowledge that is gained in terms of beliefs on one's culture, oral history or spirituality. The sacred world is all about healing of both the spiritual and physical wellbeing of all creatures (Foley, 2003). All the tenets are interconnected. In addition, humans interact with their environments, which makes it easy for them to interconnect (See figure 1 below). This shows that Science is a discipline that is based on human inferences, imagination and creativity (Govender & Zulu, 2017).

ST is a theory that uses the indigenous philosophy with three tenets: the physical world, the human world and the sacred world (Foley, 2006).

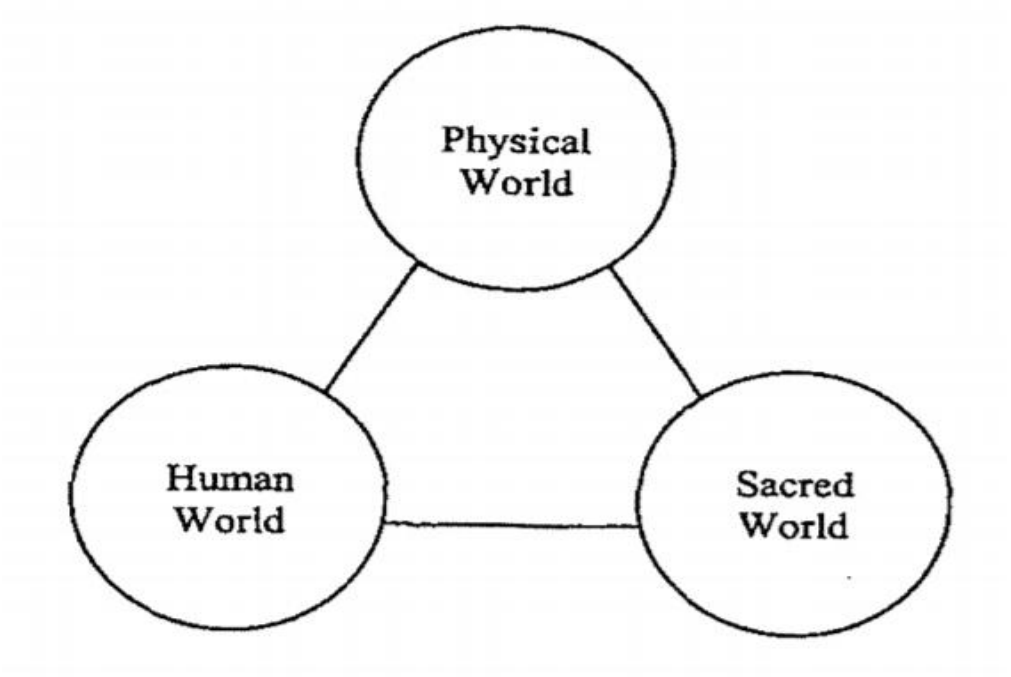

Figure 1: IST Tenets as a theory (Foley, 2003)

The physical world is between the base, which is the world or land and the creation. The land is the mother that shapes teachers' or learners' perspectives indigenously. Learners or teachers do not own the land; the land shapes them. It gives identity, channel our spirits and culture that we create, and the food we eat (Rigney, 1999).

Across the human world, there are many aspects, such as knowledge, approaches to people, family, rules of behaviour, ceremonies of people and their ability to change. The most relevant fact is the aspect of change. When the teacher integrates IK, learners, including the teacher, are expected to change automatically in terms of gaining proper entry to the Science episteme. The change consists of learners and teachers gaining knowledge of indigenous ways of living (Govender & Zulu, 2017).

The sacred world involves one's philosophy, which includes origin, nature, methods, and limits to one's knowledge (Jacobs, 2015). The limitations and methods are to be determined in every topic taught in the NS classroom to the indigenous learners (Foley, 2003).

Theory of ST stresses the teaching of Science through the integration of traditional knowledge by the teacher (Foley, 2003). Theory promotes the indigenous pedagogy where the learnt content is being contextualilsed with political, cultural, and social knowledge of the classroom of indigenous learners (Foley, 2006). In this fashion, learners will be able to relate with their indigenous communities based on their personal knowledge or perspectives. ST in NS pedagogy should acknowledge and embed indigenous communities' input where every indigenous learner comes from (Winslett & Phillips, 2005). It is then ideal that ST in the NS classroom requires teachers to integrate IK, mindful of learners' differences across their perspectives and input from indigenous communities.

2.10 Lack of literature among NS teachers' views on NOIK

The revisitation of IK upon the growing interest intrigued the researchers to research more about the inclusion of IK and views about NOIK held by teachers. Similarly, South African curricula joined in by stressing the inclusion of IK in the classroom by teachers who are knowledgeable about NOIK (Alam, 2022). Some studies have focused much of their research papers on the inclusion of IK and views on NOIK specifically in Physical Sciences and Life Sciences discipline instead of NS (Buddrus-Schiemann *et al*., 2010; De Beer & Mothwa, 2013; De Beer & Kriek, 2018). As a result, NS lack studies done on the inclusion of IK and teachers' views on NOIK. The current researcher seeks to explore the views of grade 7 NS teachers of NOIK and how these views influence their teaching.

2.11 Teachers' views on NOS in relation to NOIK

Across the world, the lack of universal and specifically IK epistemologies and their integration is an inevitable and an undoubtedly major concern in inclusive IK curricula like CAPS (Zinyeka *et al.,* 2016). This major concern can be re-established and enriched through different measures that suit or go hand in hand with the epistemologies of IK through testable and provable theories. Teachers' knowledge with regards to IK epistemologies which in short are NOIK philosophies developed over years is also a major concern in relation to the IK curriculum being deposed (De Beer & Mothwa, 2013). This study then evokes concerns about NS teachers' views on NOIK philosophies. This is due to more interrogations that have arisen in the recent literature (De Beer & Mothwa, 2013). Furthermore, this has evoked interrogations about the influence that those views have on NS classroom practice.

Few studies on teachers' view on NOIK, more specifically on the Natural Sciences discipline. This lack of studies in relation to IK epistemologies intrigues the researcher of this study to focus more on a related body of knowledge, NOS which shares some tenets with NOIK (De Beer & Ankiewicz, 2015). There is a wide range of literature about Natural Sciences teachers' views about NOS. One of the reasons why there are few studies on teachers' views about NOS instead of NOIK is because NOIK has been omitted and neglected in the past decades (Nel, 2005). As such, to better understand NS teachers' views on NOIK, we should understand the views that NS teachers hold about NOS.

As per CAPS document, NOS must be included in Natural Sciences education, and the teachers' views about NOS can be seen in their practice (DBE, 2012). Moreover, with regards to NS teachers' views on NOIK, the statistics show that majority of them hold less adequate views about NOS (Govender & Zulu, 2017). The main hindrance is that majority of teachers are reluctant to include some of the aspects of NOS (Dekkers, 2006; Kurup, 2014; Linneman *et al.,* 2003). This in turn will result in NS teachers having less adequate views about NOS; hence, bringing arguments about views that NS teachers hold about NOIK in their practice.

2.12 Relations between NOIK and NOS

2.12.1 Nature of Indigenous Knowledge (NOIK) framework

NOIK as a notion that comes from IKS through developments and practice over the years embeds the notion IK epistemologies (Pophiwa & Saidi, 2022). As the main philosophy that teachers should hold to better impact their practice, NOIK plays a recognisable role across NS classrooms (Cronje *et al*., 2015). It is concerned with understanding knowledge as units, and stresses that spirituality is embedded within this body of knowledge or philosophy. It is an undeniable truth that sections of SA learners and teachers come from indigenous communities and have lived and developed through NOIK philosophies (Kibirige & Van Rooyen, 2006). This traditional body of knowledge relies on the spiritual and continuous careful observation of nature and the passing of knowledge to the next generation (Khupe, 2014). The next generation can continue to pass the knowledge to the next generation and validate it by any means. The knowledge is continued validated by trial-and-error experiments while evolving based on experiences and community privileges to validate the knowledge through the years (Cronje *et al*., 2015).

One of the facts about NOIK as a body of knowledge is the observations of the environment within which the individuals reside. The statement casts the reality that Science, including early Science (NS), is related to NOIK as one of its features, and values the observation of the natural world. NOIK as a body of knowledge is defined by its tenets, which are discussed below as in Cronje *et al.* (2015) and Reddy (2018).

- **Empirical and metaphysical in nature**. This means that NOIK attests that Science/ nature is real, observable, and testable. Although observable, NOIK suggests that our universe is partly predictable and metaphysical and consists of supernatural events.

- **Resilient yet tentative**. This tenet simply suggests that Science is a subject that is ought to change due to proofs that avail over time, yet not forgetting that our IK is linked to people's traditional experiences, which make Science resilient.

- **Inferential yet intuitive**. This NOIK tenet suggests that Science is based on natural and unnatural causes and on the fact that both facts are tested, and experimental observation is made.

- **Creative and mythical**. The tenet imposes that Science needs human creativity and imagination. These includes myths about nature that play an important role in building Science.

- **Subjective Nature of Indigenous Knowledge**. The subjectivity comes as all humans may have influence on Science through their disciplinary and theoretical commitments. Influence includes one's beliefs, culture, spirituality, prior ways of knowing and cosmology.

- **Social, collaborative, and cultural perspectives**. The tenet stipulates that scientific laws and theories have been influenced by social and cultural collaborations.

- **Wisdom in action**. The tenet imposes that IK is better formed when there are trial and error experiences in our life to ensure survival. The better formation can be supported by repetition, imitation and ceremonies that allow the retention and reinforcement of ideas.

- **Functionally applied Science**. IK is concerned with human beings' daily life routines instead of theories, facts, and laws.

- **Holistic approach**. The holistic approach looks at a composite of diverse aspects such as Science, religion, and psychology. The tenet implies that problems that arise are solved using a holistic approach, addressing all parts with no boundaries within the metaphysical world.

The characteristics of NOIK which are a component in the Indigenous Knowledge system (IKS) are occasionally intertwined with those of NOS. The characteristics of NOIK are based on epistemology (nature and justification of knowledge), metaphysics (reality), axiology (values), and logic (complete and correct process of reasoning) (Ogunniyi, 2013).

2.12.2 Nature of Science (NOS) framework

The NS curriculum in South Africa requires an NS teacher to be able to understand NOS (DBE, 2012), which is referred to as a philosophy of Science that includes epistemology, ontology, methodology and preference (Cronje *et al.,* 2015). Furthermore, NOS narrates values and philosophical assumptions that form the base ground of scientific processes, and is often confused with scientific processes, which include data collection, analysis, and conclusions. NOS is also described using tenets, which are the ones that are comparable with the NOIK tenets. The tenets of NOS are as follows.

- E**mpirical NOS**. This tenet believes that nature is real, observable, and testable. This means that before scientists make claims, they observe, make tests, and do experimentations to gather evidence. They also believe that the world is orderly and predictable.
- T**entative NOS**. This tenet suggests that Science is subjected to change. It is believed that Science is not absolute and certain. It is a subject that is changeable depending on the findings and proofs.
- I**nferential NOS**. This tenet believes that there is a distinctive difference between observations made from nature and deductions or conclusions made from observations that are from explanations. It is believed that everything that happens has natural causes.
- C**reative NOS**. The tenet believes that the observations of nature and experiments are not the only source of scientific knowledge. Also, being creativity and imagination plays a role.
- **Subjectivity of NOS**. The tenet stipulates that scientists always strive for objectivity, but their involvement influences Science through their theoretical and disciplinary commitments. All these makes the subjectivity of NOS.
- **Social and cultural NOS**. Science is forever influenced by social and cultural practice. Scientists make their individuals work, but the knowledge is environmental based and is influenced by the universal applications.
- **Methods**. This tenet states that scientific knowledge is not generated by step-by-step methods, but scientists use a variety of methods to solve problems and theories. These methods are usually done in laboratories.

- **Theories and laws and NOS**. This tenet states that scientists use theories and laws to explain what, how and why things happen. Scientific laws explain what happens while theories explain why and how they happen.
- **Reductionist approach of NOS**. The approach states that complex phenomena can be broken into small parts and analysed. The part to whole methods are used.

2.12.3 Overlapping perspectives between NOS and NOIK

There are three viewpoints or perspectives on how people view the nature of Indigenous Knowledge and Science in Natural Sciences curricula (Zinyeka *et al*., 2016). The three perspectives are inclusive, exclusive, and overlapping perspectives. The inclusive perspective states that Indigenous Knowledge is part of Science, meaning it is embedded within Science (Steenkamp *et al*., 2019). The exclusive perspective states that Science and Indigenous Knowledge are two separate bodies of knowledge, mainly because Science foci or intentions are more about the material world (Taylor & Cameron, 2016). Indigenous Knowledge as such contrasts the main goal of Science as it includes and recognises the elements of possibility of supernatural subjectivity. Thirdly, the overlapping perspective believes that there is an overlap between Science and Indigenous Knowledge realms (Zinyeka *et al*., 2016). The perspective suggests that there are some elements (tenets) that both realms share, although each realm has its own guiding elements that make it partly unique (Taylor & Cameron, 2016).

This research goes with the overlapping perspectives viewpoint. This research study believes that the two realms are not necessarily different in all its tenets, but partly differ as such. The perspective crowns that its intention is to bridge the gap between Science and Indigenous Knowledge. The portions of uniqueness and similarities of the two realms as well as where some portions interconnects are shown in Figure 2, which was extracted from Zinyeka *et al.* (2016) and Taylor and Camerron (2016). The interconnectedness of the perspective comes with explanations of how the two are at some points overlapping. Overlapping perspective commemorate both, the cohesions (shared tenets, e.g., both are empirical and inferential) and the uniqueness of each knowledge domain (e.g., Indigenous Knowledge is holistic and western Science reductionist) (Zinyeka *et al*., 2016). Taking into consideration the

perspective would mean that the foci in the NS classroom would have shared the two realms when the NS teacher is doing their practice.

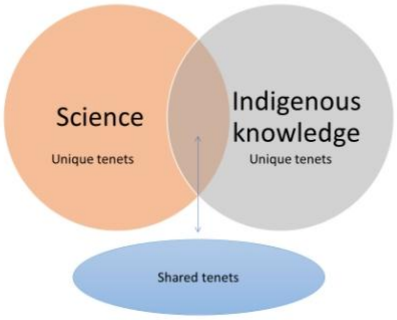

Figure 2: The overlapping perspective, recognising the shared tenets between IK, which is embedded in NOIK and NOS, including difference in tenets for both body of knowledge (Zinyeka et al., 2016; Taylor & Cameron, 2016).

This results in the two knowledge domains support and build on each other (Zinyeka *et al.,* 2016). Taylor and Cameron (2016) believe that the distinction between the two types of knowledge domains or perspectives is important in understanding the uniqueness of each knowledge domain. This perspective provides a place for Indigenous Knowledge in the school Science curriculum. This means that a teacher who is knowledgeable in NOS tenets is knowledgeable in NOIK tenets, meaning they may be able to integrate IK.

An example of this approach would be the practice explained by De Beer and Whitlock (2009), whereby a teacher could contextualise a problem in terms of Indigenous Knowledge and expects the learners to use the processes of Science to investigate the problem. How will the efficacy of 'muthi plants' be tested in the classroom? De Beer and Whitlock (2009) describe an adapted Kirby-Bauer technique whereby learners can determine the antimicrobial properties of medicinal plants. Similarly, De Beer and Petersen (2017) explain how the ancient Chinese practice of burning incense to ripen fruit could be investigated in the school laboratory. Learners will have to formulate hypotheses and develop a laboratory protocol to determine the influence of ethylene on plant growth. The criticism of such an approach would be that scientific processes are used to verify (accredit)

Indigenous Knowledge. In this approach, the teacher should also acknowledge that aspects of Indigenous Knowledge (the metaphysical) fall outside the scope of Science.

The main relationship that both bodies of knowledge have is tenets that correspond (See Appendix A, from Cronje *et al.,* 2015 p.5-6).

2.13 Tenets of the NOIK framework in relation to the tenets of NOS framework

The two bodies of knowledge, NOIK and NOS should not be separated or compared based on methodological or contextual factors (Agrawal, 1995; Sillitoe, 2019). The relations between the two bodies of knowledge is illustrated above, as the researcher went with the overlapping perspective way of viewing them.

The only mode that bodies of knowledge NOS and NOIK relate is through tenets (Zinyeka *et al*., 2016). From tenets 1-4, both bodies of knowledge agree that nature is real, observable, and testable. They are both changing through time as they are based on natural cases, and they depend on human creativity and imagination (Taylor & Cameron, 2016). In tenet 5, they both believe that scientific knowledge can be subjective while in tenet 6, they both believe that scientific laws and theories are influenced by social practice and culture. In tenets 7, they both believe that trial and error can be used to generate scientific knowledge (Zinyeka *et al*., 2016). As much as majority of both bodies of knowledge tenets resemble the same intentions, they are more likely to interchange when applied. They both believe that the universe which consist of nature is orderly (Taylor & Cameron, 2016).

2.14 Impact of Integrating IK by a teacher who holds views on NOIK

The integration of IK by NS teachers and the impact of NOIK knowledge in culturally diverse Science classrooms might make Science more relevant to pupils (De Beer & Whitlock, 2009; De Beer & Kriek, 2018). The knowledge that pupils hold, or personal or traditional knowledge is regarded as their existing IK (Kaino, 2013). Learners from indigenous backgrounds, which is the majority of learners in South Africa, experience conflict between contents learnt in their NS classrooms and their personal knowledge (Kibirige & Van Rooyen, 2006; Alam, 2022). The incorporation

of IK in Natural Sciences education by NS teachers with knowledge in NOIK has proven to irradiate the conflict between the two knowledge bodies and build learners with positive experiences and attitudes (De Beer & Mothwa, 2013). Moreover, one of the ways to integrate IK into NS content is to train NS teachers to localise Science they are teaching in a way in which it reveals learners' traditions in the classroom. This may show if the localisation of IK has influence in the classroom (Sjøberg & Schreiner, 2010). The integration by the teacher depends on his/her views of the NOIK and how they integrate IK in their classroom (Cronje *et al.,* 2015).

2.15 Why Nature of Indigenous Knowledge matter in NS teachers' practice

Every teacher's cultural knowledge is vital to Natural Sciences education (Jacobs, 2015). It is better for a Science teacher to practice their pedagogy with understanding of their environment, personal and political knowledge (Foley, 2006; Carlson *et al.,* 2019). The understanding of the three aspects allows the teacher to be able understand what view each learner brings into the classroom. Moreover, when NS teachers have adequate knowledge of their environment, personal and political spheres, the easier it is for them to integrate IK with early Science. This makes it possible for the current researcher to explore their views and the influence of those views in their classroom.

2.16 Conclusion

The above chapter briefly outlined what other researchers have done with regards to NOIK and the integration of IK. Most studies revealed how the integration of IK was omitted in the past curricula and its inclusion in contemporary times. Due to lack of literature about NS teachers' views on NOIK, the researcher has elaborated that NOIK can be integrated using a related body of knowledge (NOS). This chapter revealed the kind of perspective the researcher goes with in terms of NOIK and NOS. In conclusion, the researcher had the background of what other researchers have researched about regarding NOIK and the integration of IK.

Chapter 3: Research Methodology

3.1 Introduction

Chapter 3 is aligned with detail background of the collection and analysis of data linked to the contemporary literature in the previous chapter 2. The chapter focuses on the research methodology used in this study. Here, the researcher explains the study paradigm, study approach and the research design. In addition, the researcher provides an explanation of the methods of sampling or selection of participants, data collection and data-analysis. Quality criteria, restriction and honest reflections of this study are also outlined in this chapter.

3.2 Research approach

This current research has employed the qualitative research approach, which considers interrelationships between a phenomenon and its context wherein the researcher uses observations as one of the protocols to collect data (Stake, 1995). Furthermore, the qualitative approach allows the researcher to do observations first then conclusions rather than draw and prove a hypothesis. Similarly, the researcher of this study has observed grade 7 NS teachers in their classrooms to obtain qualitative data regarding their views on NOIK and how these views influence their classroom.

3.3 Population and sampling

The population of 20 Grade 7 NS teachers in Dimamo Circuit in Capricorn South District was used to determine the sample, thus, purposive and convenient sampling were used. Purposive sampling is a non-probability sampling that is nominated based on the objectives of the study and characteristics of the population, while convenient sampling involves a sample selected from the part of population that is at proximity (Merriam, 1998). Out of the 20 population of grade 7 NS teachers, 6 teachers were purposively and conveniently sampled to participate in the study. The researcher was specifically looking for grade 7 NS teachers at proximity, hence time management was observable.

3.4 Research design

This research study has employed exploratory and multiple case study designs because they allow the researcher to explore two or more cases under one study. Therefore, this study has included 6 NS sampled teachers, each acting as a case (Stake, 1995). In this study, the design used has enabled the researcher to explore multiple cases where participants were observed and explored across all the boundaries of NOIK. The ideal under the cases is that they are empirical wherein observations are vital and interpretive where the subject and the researcher interact. The multiple case study design is suitable for this study as it allows one to have multiple subjects acting as cases, and at the same time, allow the researcher to have his/her own integrated system. Further, this research study was a multiple parallel case study because I examined four cases at the same time (Thomas, 2011; Vasil. 2019).

3.5 Data collection

As a result of its qualitative nature, the study has an advantage of having multiple sources in one study (Msimanga, 2013). Thus, the study used three data collection instruments, namely, classroom observations using the observation schedule, open-ended questionnaire named Views on Nature of Indigenous Knowledge (VNOIK) designed by Cronje, De Beer and Ankiewicz (2015), and lastly, semi-structured interviews. The rational of using these instruments is justified below. During lesson observations, the researcher used an observation schedule. To determine that the teacher answered the questions in accordance, the researcher used the VNOIK framework in chapter 2 in 2.12.1 adopted from Cronje, De Beer, and Ankiewiczs (2015.

Data collection was done immediately after presenting the proposal and being approved with ethical clearance. Before the lesson observation, the researcher provided the VNOIK questionnaire, which the participants were able to fill or complete later after the lessons. The questionnaire was administered to address question 1 of the study, which is: what are Natural Sciences teachers' views on NOIK? They were encouraged that there were no right or wrong answers. The researcher was only interested in their views in each question.

Data collection took two consecutive days in participants' NS classrooms. In addition, on the second observation, each participant was interviewed. On day one, each NS teacher was observed passively. The same procedure was followed on day two, and the participants were also interviewed. The six cases resided on different locations but locally, making the data provided reliable.

3.5.1 Classroom observation using observation schedule

The classroom observation schedule is an instrument aimed at assessing how teachers employ their teaching strategies and methods in their classroom practice. The researcher who act as a passive observer explored the influence of NS teachers' views on NOIK when they are doing their practice. Therefore, research question number 2 on how NS teachers' views on NOIK influence their practice was answered using this instrument. Six (6) NS teachers were observed by the researcher once in different lessons. The researcher also completed the observation schedule forms against teachers' pedagogy on IK to establish the answer to research question number 2.

3.5.2 Open-ended questionnaire (VNOIK)

VNOIK was developed and validated by Cronje, De Beer and Ankiewicz (2015). The researcher reached out to the authors for permission to use the instrument. Due to the qualitative nature of the study, it allows researchers to employ the VNOIK instrument as it addresses teachers' views on NOIK. This is an instrument used in IK research in the form of open-ended questionnaires to determine teachers' views about NOIK (Cronje *et al*., 2015). In context, it is aimed to determine a wide range of views on NOIK. Furthermore, one of the research questions of the study was aimed at determining their views on NOIK. Hence, all six sampled teachers out of 20 were required to fill the questionnaire to the best of their abilities.

3.5.3 Semi-structured interviews

Qualitative approach allows us to conduct semi-structured interviews (SSI) as a standard procedure. SSI is a type of interview that is conducted verbally with one participant at a time (Adams, 2005). In addition, the researcher could have asked questions with "why" or "how" follow-up questions. In this essence, an SSI was

conducted with all six sampled grade 7 NS teachers to get their views about their lessons or based on the knowledge that they have. The questions were based on the teachers' pedagogy and their personal experience. Each teacher was given 40 minutes to provide responses during the SSI.

3.6 Data analysis

This research study as aligned to Stake (1995) methodology used Direct Interpretation with thematic content analysis as methods of analysing data. Direct interpretations are a way of analysing data that depend on the search of patterns and consistency (Mishra, 2021). In these cases, the patterns will be established and shown by coding inductively, which include deriving codes from the raw data. In thematic content analysis, themes from collected data were inductively identified and analysed while the other two methods just required the establishment of patterns and the development of naturalistic generalisations (Anderson, 2007). All themes came from naturally collected data, which in this case are from each subject or case.

3.6.1 Data analysis from Open-ended questionnaire (VNOIK)

From the VNOIK questionnaire conducted as a pre-intervention, a VNOIK rubric was used as a guideline, where coding and evaluation in relation to the rubric was drawn. At the end, teachers' views were categorised as informed (I), which weighs 2, partially informed (PI), which weighs 1, and Uninformed (UI), which weighs 0. The three classifications were given themes during analysis. The table below was used as a guideline to determine participants' responses to the VNOIK questions.

Table 1: VNOIK questionnaire with responses (rubric) drawn verbatim (Cronje, 2015, p. 126-129)

Question	VNOIK questionnaire and correct responses from each question
1	*"What Indigenous Knowledge is*: Ways of knowing nature and skills by people living in a particular area (local) and society to enhance everyday lives. Derived from interactions between people and the environment. Results of practical rendezvous in everyday life. Folk knowledge of flora and fauna. Cultural beliefs and history of their people – includes songs, rituals,

	dances and holy places. Spiritual beliefs (metaphysical) play a big role, and ancestors are important. Include rituals, myths, customs and values. Mostly passed from one generation to the other orally, through imitation and demonstration, by paintings and artefacts Collection of knowledge systems such as language, medicine, ecology, Science, religion, agriculture, astronomy, and architecture – more than just medicinal plants Holistic and inclusive in nature – co-existence of spiritual, natural and human worlds"
2	*"Role of experiments?* Facts generated by Indigenous Knowledge are derived through experimental observation and tests. Generated through trial-and-error experiments, success and failure Tested over many generations in the laboratory of life Indigenous Knowledge is empirical rather than theoretical knowledge. Relies on intuition and evidence"
3	*"Natural and unnatural causes?* Cannot separate Indigenous Knowledge from spirituality, beliefs, and metaphysics Explanations for observations in Indigenous Knowledge do not always have natural or logical causes that are predictable. Can refer to e.g., evil spirits, visions and myths in explanations. Honouring of ancestors in explanations The use of medicinal plants, for example, goes deeper than focusing on the chemical reactions occurring in the body, but consists of a holistic approach that includes the metaphysical and spiritual."
4	*"Stays the same or changes over time?* Most of this wisdom in action is passed on over generations and stood the test of time (resilience), but each generation also adapts and adds change to this knowledge as their circumstances and environment change to survive and solve problems.

	This new way of knowing is then passed on to the next generation. Indigenous Knowledge is fluid and transforming, constantly changing but often represented as static.”
5	*“How is knowledge generated? (Hoodia)* It is based on experience and needs that exist in everyday life. It is generated through trial and error. Tested over many generations and passed on from one generation to the next Collective database of observable knowledge Repetition assists with retention Ancestors or dreams inform traditional healers of elders on which plants to use.”
6	*“Used to solve contemporary problems?* Indigenous Knowledge is a source of wealth to solve current problems. Has a large role to play where modernisation has been unsuccessful in societies Has stood the test of time, tested over centuries, and can be used to solve contemporary problems”
7	*“Methods and advice?* Methods: Holistic approach – physical systems are examined holistically from social, historical, and spiritual aspects Importance of asking ancestors for help Search for a trigger that has created the disease to establish healing – may be metaphysical Advice/treatment Provide medicinal plants or *muthi* Healing goes deeper than the medicine (*muthi*) and includes energy and spirituality Rituals and beliefs also play a role. Treatment is also holistic, addressing spiritual and physical”
8	*“Role of myths* Indigenous Knowledge is transmitted orally through stories and myths.

	Imitation, demonstration and rituals play an important role. Use of metaphors Indigenous Knowledge is made understandable through stories containing lessons.”
9	*“Reflect social and cultural values?* Indigenous Knowledge does reflect the social and cultural values of a specific community. Knowledge is a critical part of culture and is adapted to a specific culture and environment. Embedded in the local social and cultural values of a certain group of people Indigenous Knowledge is situated within cultural traditions – it is not culture free. Applied locally or universally? Indigenous Knowledge is transferred across communities, cultures, and countries. Threat of exploitation Can be adapted to solve contemporary problems, but is unique to a given culture If applied to other communities’ functionality must be kept in mind Sometimes distributed in fragments and not in totality Contributions can be used to solve problems in different fields such as ecology, medicine, agriculture, mathematics, and fisheries."
10	*“Imagination, creativity* Indigenous Knowledge is a living knowledge base and is dynamic and continually applies creativity and innovation to sustain the lives of people. Generates new knowledge as new issues develop e.g., HIV/Aids Indigenous Knowledge is constantly being produced and reproduced. Undergoes constant adaptation as needs of community change.”

3.6.2 Data analysis from classroom observation

By using thematic content analysis, an observation protocol filled by the researcher with the six NS teachers was used to create themes. Themes from the observation protocol questions were used to draw natural generalisations. In all themes, criteria were based on description ‘never occurred’ as falling on a lower criterion and ‘very descriptive’ as falling on a higher criterion.

3.6.3 Data analysis from semi-structured interviews

Themes again were extracted from the semi-structured interview instrument. The analysis of themes was based on the criteria that the NS teacher either gave a less descriptive answer, a moderate answer, or a more descriptive answer with codes 1, 2 and 3, respectively. All themes from SSI by the teachers were analysed.

3.7 Quality criteria

Quality criteria or verification is integrated into every step of the processes included in the research study and constituted the rigor and trustworthiness of the research study (Creswell, 2003). Dependability, confirmability, and credibility were set as criteria to prove the trustworthiness and consistency of the study due to its qualitative nature (Lincoln & Guba, 1985).

3.7.1 Dependability

Dependability correlates with the notion of reliability, and it is the stability of research data over time and conditions (Pieterse, 2014). To ensure dependability, the researcher aligned all the study procedures and methods of collecting data in a way that others can use the same procedures and methods to conduct their studies.

3.7.2 Confirmability

Confirmability can be ensured by peer review (Suter, 2012). Therefore, two supervisors of this study have confirmed the analysis of data and findings of the study.

3.7.3 Credibility

Credibility or the internal validity of a study ensures that the research achieves what it has intended to. Credibility seeks to measure the authenticity of participant views, and applies on the methods, data presentation and findings, and as well as the interpretation of findings and adequate answers to the research questions. To establish the credibility of the study, triangulation has again played a role. Secondly, the participants (teachers) received a copy of their responses on the questionnaires and interviews to confirm their responses and the accuracy of the data provided.

3.8 Ethical Considerations

Certain ethical issues that include ethical clearance, informed consent, non-malfeasance, and beneficence should be followed in every study (Creswell, 2009). This is because research itself consists of human participation and therefore humans have rights that are to be protected during the study.

3.8.1 Ethical clearance

The researcher of this study has obtained ethical clearance from the registered institution before any important aspects under ethical issues.

The ethical clearance was obtained after presenting the proposal to the school department panel accompanied by their interrogation. Permission to conduct the study was highly considered.

Emails were sent to the developers of the instruments to request for permission.

This study was conducted in six primary schools in Dimamo Circuit, Capricorn South District in Limpopo Province.

3.8.2 Informed consent

Anyone who is a participant in the study was aware of general agreements about what is proper and improper, and made sure that the study does not include bias and discrimination (Babbie, 2007). Participants were allowed to choose to participate or

to withdraw from the study. The participants were purposively sampled mainly because they were NS teachers.

The study included letters and informed consent to schools and participants or individuals as a way of asking for permission and information, confidentiality. This will be done through consent forms 1 and 2 in the appendix section and letters provided.

Both forms played a role in which study participants are informed of critical data regarding the study, such as risks and benefits, before deciding whether to participate (Nnebue, 2010). The participants were gently taught both forms and were notified that they have the option to leave the study at any time. In other words, the researcher made certain that participants understand the logic as well as the goals and objectives of the study.

3.8.3 Permission

The researcher at first made a request for ethical clearance from Turfloop Research and Ethics Committee (TREC). Permission from the principal of the school concerned, Dimamo Circuit and Limpopo Department of Education were requested. After obtaining permission, the researcher then issued out consent forms to grade 7 NS teachers. Once the consent and permission from the concerned teachers were gained, they agreed to participate in the study.

3.8.4 Potential risks to participants

When the researcher introduced the study to potential participants, they were informed of their rights to withdraw if they somehow felt uncomfortable during the process. Participants were assured that there would be no scores for the activity, which would not be used for any school-based assessment. Privacy and confidentiality of the participants were assured for their written activities.

It was ensured that participants would not be exposed to any physical, mental, emotional, and social harm (van Eeuwijk & Angehrn, 2017).

3.8.5 Anonymity

Participants were not allowed to use their real names when they were engaged in the research process. They were allocated codes, and anonymity was assured again. The purpose of the codes was for easy recording, analysis and grouping. The completed responses were kept safe and secured by the researcher. Neither the educator nor the school management has had access to the information. All the responses were destroyed after the completion of the study.

3.8.6 Bias

There were no specific selection criteria for participants based on performance. That is, participants volunteered on an equal opportunity to explore grade 7 NS teachers' views on NOIK and how these views influence teachers' practice. Thus, even if some teachers decided not to take part in the process, the researcher still conducted the research study despite those who decided not to take part. Since the researcher collected data from different schools, including his, there was a need to ensure that there is no bias in the data. The researcher requested supervisors to review the conclusions. This was done with the hope that the two supervisors may see the things that the researcher missed or gaps that needed to be addressed and may be identified in the arguments. The supervisors affirmed that the research conclusions are reasonable.

3.8.7 Reliability

The same group of participants from one locality and school participated in the study to maintain consistency and to ensure the quality of results.

3.8.8 Benefits

There were no financial rewards in this study. It was simply for the goal of enhancing NS teachers' awareness of NOIK in terms of their classroom practice.

3.9 Conclusion

The chapter above has outlined the foundation to chapter 4, which has to do with data presentation and discussions. In laying the foundation, the current chapter was

presented in terms of subtopics such as the research paradigm, approach, design, sampling, data collection, analysis, and quality criteria.

Chapter 4: Results and Analysis

4.1 Introduction

Chapter 3 has presented the research design and methodology of the study. This has allowed the researcher to treat multiple cases at once (Stake, 1995). Like Creswell (2013), Stake (2000) defines a case study as the study of a "bounded system" (p. 436). According to Creswell (2013), "'Bounded' means that the case is separated out for research in terms of time, place, or some physical boundaries" (p. 13). Hence, the study has treated six NS teachers as six cases, meaning each teacher acted as a case. This chapter gives a general description of the results of the study, which are reported in four phases. Firstly, the chapter presents the profiles of teachers. Secondly, it presents the results from the open-ended questionnaire (VNOIK), followed by two classroom observations of each of the six participants and individual post interviews (SSI). In collecting data, the researcher was aware of participants' (NS teachers) physical, human and sacred 'worlds' as suggested by the theoretical framework of the study (Foley, 2006). Below is the presentation and discussion of six NS teachers' biographies and cases.

4.2 Biographic information of the teachers

The cases as stated in the above introduction were treated in exactly 12 days. Each case was treated for two days wherein each teacher had to collaborate with the researcher. So, each teacher prepared two lessons, which they taught in two days. The participants were observed once per lesson, where the researcher was a passive observer. They were then interviewed using the SSI instrument. Later, participants were given the VNOIK questionnaire to fill in responses to their knowledge about NOIK. Below is the biographic information of those teachers from teacher 1 to teacher 6 as cases and the keys with their meanings as used in the data presentation and discussions below.

Table 2: Biographical information of the six NS teachers

Keys: T1=teacher 1, Male= M, Female= F					
Case	**Gender**	**Age**	**Highest qualification**	**Major subjects**	**Years in teaching (experience)**
T_1	M	45	Diploma in Education	Mathematics and Technology	15
T_2	M	27	Bachelor in Education Senior phase and FET	English and Natural Sciences	4
T_3	F	31	Bachelor in Education Senior phase and FET	Mathematics and Life Sciences	5
T_4	F	26	Hons in Mathematics Education	Mathematics and Physical Sciences	3
T_5	M	38	Advance Certificate in Teaching	Mathematics, English and Afrikaans	15
T_6	M	40	Advance Certificate in Teaching	Mathematics, Sepedi and Afrikaans	18

4.3 Introduction on the analysis of the three instruments

From all the instruments, respective methods mentioned in chapter 3 were used to analyse data. The analysis methods used instruments like the VNOIK framework and observation schedule rubric to establish the syntheses, discussions and patterns. Before the lesson observation, the researcher provided the VNOIK questionnaire, which the participants were able to fill or complete before lesson observations. The questionnaire was administered to address question one of this study which is: what are Natural Sciences teachers' views on NOIK? Participants were encouraged that there were no right or wrong answers; the researcher was only interested in their

views from each question. All the participants, T_1-$T_{6,}$ completed their questionnaire immediately before any other instrument was used. The researcher was in no way involved during the completion of the questionnaire.

Then, a VNOIK rubric adopted from Cronje, De Beer and Ankiewiczs (2015) was used to categorise and weigh the questions answered to show whether the teacher holds either informed (I), which weighs 2, partially informed (PI), which weighs 1 or uninformed (UI), which weighs 0, per question. The VNOIK coding was synthesised using the information obtained from the VNOIK rubric where teachers are rated either I, PI and UI per question. Later, the VNOIK percentages rating was calculated per teacher's questionnaire.

To show consistency in evaluating and coding, the researcher used the VNOIK framework (chapter 2, 2.12.1) adopted from Cronje, De Beer and Ankiewiczs (2015), which allowed the researcher to determine which questions were aligned with a specific explanation of a tenet under NOIK and to establish the core components that teachers showed in their responses.

In answering question 2 of the study, which is: how do Natural Sciences teachers' views on NOIK influence their classroom practice, the researcher used an observation schedule and an SSI data. In determining if the teacher answered the questions accordingly, the VNOIK framework in section 2.12.1 was adopted from Cronje, De Beer and Ankiewiczs (2015) to determine the 'correctness' of the teacher per question. During the SSI questioning, the researcher allowed any answer in a way to determine if the teacher was satisfied with the lesson they had.

4.4 The cases

4.4.1 Case 1 results and analysis

Below is T_1 data on the VNOIK questionnaire as administered prior to the lesson observations and post-SSI.

4.4.1.1 T_1 VNOIK questionnaire results

Instructions

- From the questionnaire filled, the researcher anticipated participants' responses in line with the VNOIK rubric above. Below is T_1 anticipated responses in contrast with the rubric. The table below represents how T_1 responses were categorised and weighed.

Table 3: T1 categorised and weighed responses.

Questions	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Overall average score
Teacher 1	I	I	UI	I	PI	I	PI	I	I	I	
Weighing	2	2	0	2	1	2	1	2	2	2	2 (1.6)

The table above shows that T_1 managed to score an overall average score of 1.6 out of a possible perfect overall average scores of 2. The score shows that generally the participant has informed views of the nature of Indigenous Knowledge. The participant managed to reflect informed views on five questions out of a possible ten, which accounts for 50%. On the other hand, the participant managed to reflect partially informed views on two questions out of a possible ten, which accounts for 20%. Lastly, the participant managed to reflect uninformed views on one question out of a possible ten, which accounts for 10%. Generally, the participant's responses reflected that his views are informed.

The table below shows T_1's responses and discussions to back the above discussion and coding done based T_1's responses.

Table 4: T1 responses and analysis

Question	**NS teachers' anticipated responses to questions**
1	*"What Indigenous Knowledge is*: In relation to this question, T_1 managed to answer appropriately by stating, *"Indigenous Knowledge is people's knowledge and skills that are possessed in a particular locality which make the people to benefit from their own environment".* The accuracy involves an Informed view as Battiste (2002) defines Indigenous Knowledge as knowledge that

	results from cultural philosophies which are area or societal based.
2	*"Role of experiments?* In regard to the question, the answer by T_1 *"Indigenous Knowledge is referred to as "wisdom in action" Indigenous Knowledge engages the accumulation of knowledge through practical experiences of local people using trial and error method"*. T_1 has demonstrated an informed view as he explained the role of experiments by practitioners by including trial and error. This shows that acts generated by Indigenous Knowledge are derived through experimental observations and tests.
3	*"Natural and unnatural causes?* T_1 on this question showed an uninformed view as the response was "*The nature of Indigenous Knowledge embraces the "functional application". It involves the knowledge about the day to day living of indigenous people and the reasons behind the occurrence of things in nature".* T_1 could not separate Indigenous Knowledge from spirituality, beliefs, and metaphysics. The explanation only suggests that the practitioners of Indigenous Knowledge follow certain guidelines.
4	*"Stays the same or changes over time?* On this question T_1 has shown an informed view as the response was *"Indigenous Knowledge is "resilient yet tentative". It existed for a long period of time and pulled through many generations. New discoveries in time may lead to the change of IK with the change in traditions yet displaying flexibility and transformability".* T_1 explained in detail the resilience and tentativeness of Indigenous Knowledge.
5	*"How is knowledge generated? (Hoodia)* In determining how Indigenous Knowledge is generated, T_1 seemed to be partially informed. The response was "*I think they gathered facts about the plant through observation and testing. Practical experiments*

	are also involved where Phenomena which are natural and unnatural are observed and tested by indigenous people through experiments and make conclusions from them". The only aspect on the explanation is the aspect of repetition that assists in retention. Ancestors' knowledge passing was not involved.
6	*"Used to solve contemporary problems?* T_1 has shown Indigenous Knowledge as an initial source of strategies to solve contemporary problems on the response *"Indigenous Knowledge is viewed as a way of contextualising Science teaching and learning to sustain education development. Indigenous Knowledge of most communities coincide closely with school Science concepts. Integration of IK assists on the relevancy of Science curriculum, the link between Science and Indigenous Knowledge and the sustainable development of the education system".* The teacher eventually agrees that Indigenous Knowledge can solve today's problems.
7	*"Methods and advice?* Methods: As for methods, T_1 clearly outlines a holistic approach which shows how physical systems are examined holistically through the response: *"The traditional healer will use the trial-and-error approach where they will apply the knowledge that they observed from the past and used to make conclusions about the sickness".* Advice/treatment: The participant did not refer proper treatment from the holistic method used by saying "…*advised to use the medication or treatment gin by the medical practitioner* …" meaning the approaches are mixed. The two responses make the teacher to be portrayed as someone who holds a partially informed view on the question.

8	*"Role of myths* T_1 on the role of myths, showed an informed view as the response was: *"Indigenous Knowledge is "mythical and creative". Indigenous people have a nature of creative reasoning. There are some myths that are detected among the elderly and indigenous people and the role that they play is unique in their way of life. For example, the Tsonga community in South Africa creatively practice a myth that discourages young girls to engage in sexual activities at a tender age. It is said that having sex at a young age will result in the girls loosing parts of their hair for good"* clearly state the importance of myths.
9	*"Reflections on social and cultural values?* The teacher holds an informed view on the question as he stated that "Indigenous Knowledge does reflect social and cultural values of a specific community" mostly from the knowledge systems like Science, psychology and religion. Applied locally or universally? Acknowledgement that Indigenous Knowledge is transferred across communities, cultures and countries have been stated.
10	*"Imagination, creativity* The teacher has shown an informed view as his response "…*This knowledge engages imitating, repeating and cultural activities which allows indigenous people to keep and emphasise ideas. Indigenous Knowledge is not the final stage of knowledge discovery but a way towards gaining wisdom…"* shows that Indigenous Knowledge is a true base and dynamic in continuing to apply creativity and innovation to sustain people's lives.

From the above table, T_1 struggled with only question three, which was to determine if elders always use natural causes to explain their observations such as lightning, or if they sometimes include supernatural causes in their

explanations? The teacher in this case explained that some observations in Indigenous Knowledge do not always have natural or logical causes that are predictable. The answer given was not enough because T_1 only explained that elders follow certain guidelines referring to functional application. That alone does not show the separation of Indigenous Knowledge from spirituality, beliefs and metaphysics. That alone cannot disqualify the teacher as UI or PI. Hence, the teacher scored an overall average score of 1.6.

4.4.1.2 T_1 $L_{1\&2}$ observation schedule

Table 5: :T1 L1&2 observation schedule

T_1 $L_{1\&2}$ observation schedule				
Learning area and topic	**Heat transfer(L_1) and Law of conservation of energy(L_2)**			
Teaching method	**Lecture method ($L_{1\&2}$)**			
Number of learners	**56**			
Tenet of the NOIK	**Notes made from what is observed from the teacher (L_1)**		**Notes made from what is observed from the teacher (L_2)**	
	Pedagogical practice that illuminates teachers' views (Notes)	***What actions/strategies/approaches would show us this view? (Notes)***	***Pedagogical practice that illuminates teachers' views (Notes)***	***What actions/strategies/approaches would show us this view? (Notes)***
Empirical and metaphysical NOIK *"Nature is real, partly or generally tested and observed. Needs-based Experimentation. The universe is orderly, metaphysical and partly predictable"(Agrawal, 1995; Bohensky & Maru, 2011; Le Grange, 2007, Ogunniyi, 2004; Cronje, De Beer & Ankiewicz, 2015, p. 323).*	The teacher did not acknowledge that there are aspects in nature that have to do with energy transfer. He only explained the heat transfer process verbally. Learners listened without interaction; they did not get a chance to add to what the teacher had	The teacher in the lesson included the objects or aids like hot plates and metal rods.	Learners were not given more chances to come up with more examples in the case of Indigenous learners to better understand the concepts. Integration of IK would then be accommodated.	The teacher acknowledged that for energy to move around, it is caused by nature. The creation was by God and gods. He verbally gave an example of a hot plate stove and metal rod.

	said.			
Resilient yet tentative NOIK *"Indigenous Knowledge has withstood the test of time but is constantly changing as tradition; it is fluid and transformative—linked to people's experiences. The elders' repository of ways of knowing is truth and not to be challenged" (Barnhardt, 2008; Bohensky & Maru, 2011; Senanayake, 2006; Cronje et al., 2015, p. 323).*	The teacher did not state that the knowledge of heat transfer dated back in the days. Again, he could not show the resilience or tentativeness of NOIK during his lesson.	The teacher should have acknowledged the past under heat transfer.	The teacher did not give ancient times examples, instead he only gave one example of recent times without acknowledging ancient times.	More examples like lighting were supposed to be included. The teacher should have explained such examples to show energy flow in a way of acknowledging nature.
Inferential yet intuitive NOIK *"Facts are both tested and experimental observations made. Events have both natural and unnatural causes; metaphysical dimensions are important" (Le Grange, 2007; Ogunniyi, 2004; Senanayake, 2006).*	No experimentation was observed, nor tests done for observations.	The teacher was supposed to allow learners to work on experiments and to test so that they come up with their answers.	The teacher did not allow questions in case there were indigenous learners in his classroom who did not understand.	Teacher used the hot plate stove and a metal rod practically to prove and test that the energy is not lost but transferred. The causes of both natural and unnatural were stated by the teacher.
Creative and mythical NOIK ***"****Observations and experimenting are not the only sources of ways of knowing. Human creativity, imagination, metaphors,*	The teacher did not allow learners to work, but more talking or teaching was done by	The teacher should have been creative with examples of experiments and tests	Teacher did demonstrate using a hot plate and a metal rod, demonstrating, and	Improvisation was supposed to be allowed to allow learners to have their own metal rods for

and myths also play a role" (Barnhardt, 2008; De Beer & van Wyk, 2011).	the teacher, including answering.	that include metaphors, imaginations, and myths. And allow learners to be creative around the topic.	allowing learners to observe.	better demonstration and experimentation.
Subjectivity of NOIK *"Indigenous ways of knowing are based on cosmology and interwoven with culture and the spiritual. The elders can be influenced by prior ways of knowing and beliefs" (Aikenhead & Ogawa, 2007; Ogunniyi, 2004).*	Again, The teacher did not acknowledge the past practice regarding the topic. None of the examples was even given to the learners.	IK was supposed to be cited from the ancient times with examples like the heat transfers in the mines.	Teacher showed less origin of knowledge when he demonstrated less knowledge on NOIK in the examples he made.	Indigenous examples should be given throughout the lesson.
Social, collaborative, and cultural NOIK *"Indigenous Knowledge is situated in cultural tradition and within a certain historical–political context. It is the consequence of activities connected to everyday life in the natural environment of a group of people. It does not focus on the individual, but on the group and sharing. Indigenous Knowledge is locally rooted and ecologically based. It is generated at a*	Daily interactions acknowledgements were made verbally, specifically on the skills learners practice every day like cooking. Multiple examples were not given though.	The teacher was supposed to state multiple examples on daily skills that learners practice. Also, the teacher should have explained how heat transfer occurs in each example as stated.	Teacher showed social skills. Teacher made practical examples that learners encounter in everyday life. The example given can also track the old knowledge of the fire reaction.	More relevant teaching strategy should be selected that allows learners to comprehend knowledge from a teacher in a ground form/ peer learning.

specific place by people of that place. Indigenous Knowledge is orally transmitted Generalisations are relative within a certain context and can be shared among communities and beyond" (Agrawal, 1995, Barnhardt, 2008; Bohensky & Maru, 2011).				
Wisdom in action and NOIK *"Indigenous Knowledge is generated by practical engagement in everyday life through trial-and-error experiences. Repetition, imitation, and ceremonies are methods to aid retention and reinforce ideas. New ideas are rigorously tested in the 'laboratory of survival" (Senanayake, 2006, p. 87; Aikenhead & Ogawa, 2007; Barnhardt, 2008; De Beer & van Wyk, 2011).*	The teacher not innovative, instead he kept on explaining many aspects of the lesson. The lesson was teacher-centred.	The teacher was supposed to be innovative and allow learners to experiment and do tests in anyway related to the topic.	Teaching did not allow learners to experiment nor test. Even in the assessment part, neither experiment nor test was included in the assessment. He only articulated through verbal learning.	The teacher should use methods that allow learners to be kinaesthetic in a way to experiment.
Functional application and NOIK *"Indigenous Knowledge is concerned with what and why things happen in nature, but also with what ought to happen. Emphasis is on functional application and skills.*	The examples did not give learners applications and skills as they were not stated enough.	The teacher was supposed to give more examples related to the topic that applies to the everyday life context.	Teacher gave learners information verbally but did not enable them to come up with examples that concern their daily	Similarly, to the teachers, learners should be equipped with more knowledge through experimentation, tests,

Indigenous Knowledge is concerned with the everyday lives of people rather than facts, theories, and laws" (Agrawal, 1995, Aikenhead & Ogawa, 2007).			lives.	and examples for them to be able to integrate the knowledge with their personal knowledge.
Holistic approach of Indigenous Knowledge *"Indigenous Knowledge is 'a conglomeration of knowledge systems' (Ogunniyi, 2007a, p. 965) including Science, religion, psychology, and other fields. Problems are solved in a holistic manner addressing all the smaller parts with no boundaries with the metaphysical world" (Agrawal, 1995; Senanayake, 2006).*	The teacher did not trigger learners' curiosity, otherwise they would have come with many examples related to the topic and others would be ancient.	The teacher to trigger learners' curiosity, so that they come with many examples related to the topic.	The teacher did not elicit the curiosity of learners to come up with the examples and what they believe in.	The teacher should allow learners to stipulate what they believe in when teaching.

Observation schedule discussions

Before filling the observation schedule, the researcher observed that learners were quieter. T_1 seemed to be more interested in teaching L_1, but learners were more reserved. T_1 introduced the lesson, nevertheless. These are the observations made in respect to L_1 in respect to the observation schedule tenets of NOIK.

- On **Empirical and metaphysical NOIK**, pedagogical practices that illuminate T_1 were clear. He did not show or acknowledge the mother-nature in the introduction lesson and during the lesson. This includes the teacher's actions.
- On **the resilient and tentative NOIK**, pedagogical practices that illuminate T_1 were even clearer. The teacher did not engage learners' traditional experiences. The only routine done throughout the lesson was to involve western explanations using the textbook.
- On **inferential and intuitive NOIK**, T_1 was unsuccessful to observe the learners' traditional knowledge by eliciting it. No tests and experiments were done.
- On **creative and mythical NOIK**, T_1 could not engage the learners in a way that would intrigue them to be creative. This means that the teacher was not creative in that sense. During the lesson, no myth was said to build up the knowledge.
- On **subjectivity of NOIK**, although T_1 was verbal, he could not show subjectivity during the lesson. The subjectivity could have been shown what different scientists say about energy transfer in an open and closed environment.
- On **social, collaborative, and cultural NOIK**, the teacher was decimally unsuccessful. From the time we entered the class and during the lesson, the learners were way distant and reserved. There were no social interactions, collaborations, or engagement among learners about their culture.
- On **wisdom in action and functional application of NOIK**, there was little indication of what happens in our daily lives in relation to the topic.

On day 2, on L_2, there was not much difference done from L_1. The environment and teaching strategy were the same, where T_1 would be more vocal rather than engage learners.

Overall, to ensure the inclusion of NOIK in the NS classroom, one has to understand the context in which learners are operating (Mavuru & Ramnarain, 2018). T_1 was operating in different contexts with his learners.

4.4.1.3 T_1 Post SSI

The researcher interviewed T_1 after the second lesson observation. The interviews were semi-structured, wherein they could be asked in any sequence if the researcher feels like with any additional question/s. The SSI was conducted on T_1, and then recorded. Below are the responses and analysis.

Question 1 responses

In your view, would you say the overall lesson was a success? Why?

T_1: Ys, learners were raising their hands to show understanding.

The teacher asked questions in terms of satisfaction of the lessons. This will in turn gauge if he was aware that the integration of IK took place. However, in this case, he responded in abstract terms. He/she gauged the success of the lessons based on learners raising their hands, which was not sufficient in the first place. When measuring the overall lesson success, we checked learners' performance based on the assessment. The teacher could not draw conclusions of lesson success on the right measurements.

Question 2 responses

Are you satisfied with the way you introduced your lesson? Why?

T_1: Yes, learners seemed to have understood my introduction when I explained what heat transfer means.

The teacher's response in terms of satisfaction on lessons was asked. This in turn gauged if he was aware that integration of IK took place. However, in this case, he

responded in abstract terms. The teacher gauged the lesson's success on learners' responses to the introduction of the lesson, which was inappropriate in the first place. When measuring the overall lesson success, we checked learners' performance based on the assessment. Hence, the teacher was unsuccessful in drawing conclusions of the success of the lessons on the right measurement.

Question 3 responses

Are you satisfied with your interaction with the learners? Why?

T_1: Yes, this is because we engaged in a question-and-answer session through collaborations.

As a facilitator, the teacher was unsuccessful in the aspect of withitness of the classroom. If the teacher was observant and reflective, all the aspects of the classroom about interactions in lessons should have been considered, not only the aspect of learners' ability to collaborate in question-and-answer sessions. The teacher was unsuccessful in unwinding in detail all the aspects of the lessons he had, which includes assessment.

Question 4 responses

Would you say you used the relevant teaching method in this class? Why?

T_1: Yes, learners were quick to catch the wording relating to the past topic "the law of conservation of energy". Again, the teacher became abstract in his reasoning, despite the probing question why. The teacher's reasoning was not enough. Details should also include the factor of assessment as a major check of the relevance of a teaching method/s.

Question 5 responses

If there were some things you could change about your lesson, what would it be and why?

T_1: I would change my time and classroom management; some learners were interruptive.

The factor of learners' interruption simply shows that the lesson lacked somewhere. Across all discussions, my observation shows that the teacher was unsuccessful to

include the factor of assessment as room for improvement. He was unsuccessful in all reasoning to include assessment as a major factor.

Overall discussions

The interviews took place on the second day or after the second lesson. As the researcher administered the SSI, the teacher was satisfied. During the administration of SSI, T_1's answers revealed a different perspective. He seemed most satisfied with his lessons. The reasons were that some learners raised hands, channelling T_1 to be convinced that the lesson was a success. However, I think the aspect of assessment as part of reasoning was neglected.

4.4.2 Case 2 results and analysis

Below is T_2 data on the VNOIK questionnaire as administered prior to the lesson observations and post-SSI.

4.4.2.1 T_2 VNOIK questionnaire results

Instructions

- From the questionnaire filled, the researcher anticipated the participants' responses in line with the VNOIK rubric above. Below is T_2's anticipated responses in contrast with the rubric. The table represents how T_2's responses were categorised and weighed.

Table 6: T2 categorised and weighed responses

Participant	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Overall score
Teacher 2	PI	UI	PI	I	PI	PI	I	I	PI	UI	
Weighing	1	0	1	2	1	1	2	2	1	0	1 (1.1)

- The table above shows that T_2 managed to score an overall average score of 1.1 out of a possible perfect overall average score of 2. Nevertheless, the score shows that generally the participant has informed views of the nature of Indigenous Knowledge. The participant managed to reflect informed views on three questions out of a possible ten, which accounts for 30%. On the other hand, the participant managed to reflect partially informed views on five

questions out of a possible ten, which accounts for 50%. Lastly, the participant managed to reflect uninformed views on two questions out of a possible ten, which accounts for 20%. Generally, the participant's responses indicated that his views are informed as the overall average score is 1.1, which surpasses 1.0.

Table 7: T2 responses and analysis.

Question	NS teachers' anticipated responses to questions
1	*"What Indigenous Knowledge is*: In relation to this question, T_2 managed to answer semi-appropriately by stating *"Indigenous Knowledge / traditional knowledge is knowledge gained from home or local community by an individual. It differs from other knowledge/s because other knowledge is gained from being taught in the institutions while Indigenous Knowledge does not need teaching it acquired through actions and copying".* The accuracy involves a partially informed view as Battiste (2002) defines Indigenous Knowledge as knowledge that results from cultural philosophies which are area or societal based. The tenets of NOIK were not fully engaged in the response.
2	*"Role of experiments?* Regarding the question, the answer by T_2: *"No, because they observe their elders and acquire knowledge from their actions. Then they start applying that to their everyday life"*. T_2 has showed uninformed view, as the answer was that practitioners do not use or involve experiments but they regard 'experimentation' as observing their elders and imitate them.
3	*"Natural and unnatural causes?* T_2 on this question showed a partially informed view as the response was: "*The nature of Indigenous Knowledge involves the knowledge about the day to day living of indigenous people and the reasons behind the occurrence of things in nature".* T_2 could

	separate Indigenous Knowledge from spirituality, beliefs and metaphysics. The explanation did not suggest that the practitioners of Indigenous Knowledge follow certain guidelines.
4	*"Stays the same or changes over time?* On this question T_2 has shown an informed view as the response was *"Sometimes practitioners of Indigenous Knowledge change some information to fit the situation or condition, which can go changed over years".* T_2 was explaining the resilience and tentativeness of Indigenous Knowledge in the response.
5	*"How is knowledge generated? (Hoodia)* In determining how Indigenous Knowledge is generated, T_2 seemed to be partially informed. The response was: "*The information could be originating from first ancestors of Khoi-Sans, who experienced and passed to the next generations".* The only aspect on the explanation is the aspect of repetition that assist in retention. Ancestors' knowledge passing was not involved.
6	*"Used to solve contemporary problems?* T_2 has not shown Indigenous Knowledge as an initial source of strategies to solve contemporary problems in the response *"Because hunger has been there over years and different tribes knew how to deal with it. Even today, they can use the same methods and traditional ways in order to win the sustainable development".* The teacher eventually agrees that Indigenous Knowledge can solve today's problems.
7	*"Methods and advice?* Methods: As for methods, T_2 clearly outlines a holistic approach which shows how physical systems are examined holistically through the response: *"The traditional healer will at least give the athlete something to apply*

	on the affected area; like herbs that can be rubbed against the spot". Advice/treatment: The participant excelled by referring to proper treatment from the holistic approach used by saying: "*The advice that can be given can be to always have the rub herbs for in case. And they are usually applied before going to the match or competitions*" meaning the approach is the same. The two responses make the teacher to be portrayed as someone who holds an informed view on the question.
8	*"Role of myths* T_2 on the role of myths seemed to have an informed view based on his response: *"Indigenous Knowledge "Yes, myths play important role in Indigenous Knowledge system. In communities, they make people safe and to keep on believing in them. Example can be that there are mermaids in certain rivers. So, people will not go anywhere near the rivers with mermaids for safety and if they go and come back, their beliefs will be boasted, and this* clearly states the importance of myths.
9	*"Reflect social and cultural values?* The teacher holds an informed view on the question as he stated that: "*I believe that Indigenous Knowledge can be used and reflects the social and cultural values of a specific community. These can be seen as many communities have different practice. For example, preference in the gender of a ruler (Queen-ship or kingship)* from the mostly knowledge systems, like Science, psychology and religion. Applied locally or universally? Acknowledgement that Indigenous Knowledge is transferred across communities, culture and countries has been stated without examples.
10	*"Imagination, creativity*

	The teacher showed uninformed view as his response: "*Indigenous Knowledge cannot be changed; we imitate from our parents who took the knowledge from their fore-parents. Example can be some indigenous remedies like 'lengana' to cue flue"* shows Indigenous Knowledge is not a true base and a dynamic in continuing to apply creativity and innovation to sustain people's lives as example given did not show any creativity or imagination.

On the accounts of 50% partially informed and 20% informed and weighing of 1.1, the questions that caused a fall on the overall average score are questions 2 and 10 for T_2. Question two required an explanation on the question, do elders do experiments and tests to verify or validate this knowledge? T_2 was unsuccessful to explain in relation to trial and error or fully acknowledged that elders regard Indigenous Knowledge as derived through experimental observation and tests. In question 10, posted as: do current practitioners of Indigenous Knowledge use this knowledge exactly as it was passed on to them, or can they use their creativity and imagination to modify the Indigenous Knowledge to solve current problems? The teacher was unsuccessful to acknowledge that IK is true base and dynamic in continuing to apply creativity and innovation to sustain people's lives.

4.4.2.2 T_2 $L_{1\&2}$ observation schedule

Table 8:T2 L1&2 observation schedule

T_2 $L_{1\&2}$ observation schedule				
Learning area and topic	**Potential and kinetic energy (L_1) heat transfer (L_2)**			
Teaching method	**Lecture method ($L_{1\&2}$)**			
Number of learners	**50**			
Tenet of the NOIK	**Notes made from what is observed from the teacher (L_1)**		**Notes made from what is observed from the teacher (L_2)**	
	Pedagogical practice that illuminates teachers' views (Notes)	***What actions/strategies/approaches would show us this view? (Notes)***	***Pedagogical practice that illuminates teachers' views (Notes)***	***What actions/strategies/approaches would show us this view? (Notes)***
Empirical and metaphysical NOIK *"Nature is real, partly, or generally tested and observed. Needs-based experimentation. The universe is orderly, metaphysical, and partly predictable"* (*Agrawal, 1995; Bohensky & Maru, 2011; Le Grange, 2007, Ogunniyi, 2004; Cronje, De Beer & Ankiewicz, 2015, p. 323).*	Teacher acknowledged that for energy to move around it is caused by nature. He verbally gave an example of a hot plate and a metal rod.	Learners should be given a chance to express their Indigenous Knowledge. Integration of IK would then be accommodated.	The teacher did not acknowledge that there are aspects to do with energy transfer. He only explained the heat transfer process which includes objects like hot plate and metal rod.	Learners only listened without interaction. They did not do what teachers instructed them to do in terms of examples.
Resilient yet tentative NOIK *"Indigenous Knowledge has withstood the test of*	Teacher continued teaching. He did not give ancient times	More examples like lighting, the teacher should explain such	The teacher did not state that the knowledge of heat transfer dated back	Again, learners could not show resilient of NOIK or its tentativeness. This

time but is constantly changing as tradition; it is fluid and transformative linked to people's experiences. The elders' repository of ways of knowing is truth and not to be challenged" (Barnhardt, 2008; Bohensky & Maru, 2011; Senanayake, 2006; Cronje et al., 2015, p. 323).	examples. Only one example, that of not plate and metal rod.	examples to show flow of energy.	in the days. No ancient examples were stated.	shows that the teacher did not allow them.
Inferential yet intuitive NOIK *"Facts are both tested and experimental observations made. Events have both natural and unnatural causes; metaphysical dimensions are important" (Le Grange, 2007; Ogunniyi, 2004; Senanayake, 2006).*	Teacher used the hot plate and a metal rod to prove that the energy is not lost.	More questions would be allowed in case there are indigenous learners who don't understand.	The teacher did not perform any experimentation but explained the movement of gas particles.	The teacher was supposed to allow learners to experiment on heat transfer and allow them to date back on the years.
Creative and mythical NOIK ***"****Observations and experimenting are not the only sources of ways of knowing. Human creativity, imagination, metaphors, and myths also play a role" (Barnhardt, 2008; De Beer & van Wyk, 2011).*	Teacher demonstrated using a hot plate and a metal rod, allowing learners to observe.	I would have improvised and allowed all learners to come with their metal rods for better demonstration and experimentation.	The teacher did not allow learners to work, but did more work. The teacher did most of the answering.	The teacher should have been creative with examples that include metaphors, imagination, and myths. Allow learners to be creative around the topic.

Subjectivity of NOIK *"Indigenous ways of knowing are based on cosmology and interwoven with culture and the spiritual. The elders can be influenced by prior ways of knowing and beliefs" (Aikenhead & Ogawa, 2007; Ogunniyi, 2004)*	Teacher showed less origin of knowledge when he demonstrated less knowledge, pertaining examples.	Indigenous Knowledge examples should be given more throughout the lesson.	Again, the teacher did not portray more examples or any inter-link from the past.	Indigenous Knowledge was supposed to state with examples like in ruins. How were some metals melted due to heat transfer?
Social, collaborative and cultural NOIK *"Indigenous Knowledge is situated in cultural tradition and within a certain historical–political context. It is the consequence of activities connected to everyday life in the natural environment of a group of people. It does not focus on the individual, but on the group and sharing. Indigenous Knowledge is locally rooted and ecologically based. It is generated at a specific place by people of that place. Indigenous Knowledge is orally transmitted Generalisations are relative within a certain context and can be shared among communities and beyond" (Agrawal, 1995, Barnhardt, 2008; Bohensky & Maru, 2011).*	Teacher showed some social skills. Teacher made a practical example of what the learners encounter in everyday life. The example given can also trick the old knowledge of the fire reaction.	More relevant teaching strategy should be selected that allows learners to comprehend knowledge from a teacher in a group form /peer learning.	Daily interaction acknowledgement was not made, specifically on skills learners practice every day like cooking. No examples were given as such.	The teacher was supposed to explain at least multiple examples on daily skills that learners practice. Explain how heat transfer occur in each scenario.

Wisdom in action and NOIK *"Indigenous Knowledge is generated by practical engagement in everyday life through trial-and-error experiences. Repetition, imitation, and ceremonies are methods to aid retention and reinforce ideas. New ideas are rigorously tested in the 'laboratory of survival" (Senanayake, 2006, p. 87; Aikenhead & Ogawa, 2007; Barnhardt, 2008; De Beer & van Wyk, 2011).*	The teacher did not allow learners to experiment, not even during the assessment part. He only articulated through verbal learning.	Methods that allow learners to be kinaesthetic should be employed to allow learners to experiment.	The teacher not innovative, instead he kept on explaining many aspects of the lesson. The lesson was teacher-centred.	The teacher was supposed to be innovative by allowing learners to expect heat in any way
Functional application and NOIK *"Indigenous Knowledge is concerned with what and why things happen in nature, but also with what ought to happen. Emphasis is on functional application and skills. Indigenous Knowledge is concerned with the everyday lives of people rather than facts, theories and laws" (Agrawal, 1995, Aikenhead & Ogawa, 2007).*	Teacher gave learners the knowledge that can enable them to come up with examples that concern their everyday life.	Similar to the teacher, I would equip learners with more knowledge and examples for them to be able to relate and integrate their personal knowledge.	Teacher examples do not give learners application and skills as she did not state enough examples.	The teacher was supposed to give examples that apply in everyday life context.

Holistic approach of Indigenous Knowledge *"Indigenous Knowledge is 'a conglomeration of knowledge systems' (Ogunniyi, 2007a, p. 965) including Science, religion, psychology, and other fields. Problems are solved in a holistic manner addressing all the smaller parts with no boundaries with the metaphysical world" (Agrawal, 1995; Senanayake, 2006).*	The teacher did not elicit curiosity for learners to come up with what they believe in.	The teacher ought to trigger learners' curiosity so that they come with many examples related to the topic.	The teacher not innovative enough, otherwise learners would've come up with more examples either religious, psychological, among others.	Teacher ought to be innovative to allow learners to come up with their personal knowledge.

Observation schedule discussions

Before filling in an observation schedule, the researcher observed that learners were quiet. T_2 seemed to be more interested in teaching L_1, but learners were more reserved. He introduced the lesson nevertheless. These are the observations made in respect to L_1 in respect to the observation schedule tenets of NOIK.

- On **Empirical and metaphysical NOIK**, pedagogical practices that illuminate T_2 were clear. However, he did not show or acknowledge the mother-nature in the introduction lesson and during the lesson. This includes the teacher's actions.
- On **the resilient and tentative NOIK**, pedagogical practices that illuminate T_2 were even clearer. The teacher did not engage learners' traditional experiences. The only routine done throughout the lesson was to involve western explanations using the textbook.
- On **inferential and intuitive NOIK**, T_2 was unsuccessful to observe the learners' traditional knowledge by eliciting it. No tests and experiments were done.
- On **creative and mythical NOIK**, T_2 could not engage the learners in a way that would intrigue them to be creative. This means that the teacher was also uncreative in that sense. During the lesson, no myth was said to build up the knowledge.
- On **subjectivity of NOIK**, although T_2 was verbal, he could not show subjectivity during the lesson. The subjectivity could have been shown how different scientists say about energy transfer in an open and closed environment.
- On **social, collaborative and cultural NOIK**, the teacher not so informative. From the time we entered the class and during the lesson, the learners were way distant and reserved. No social interactions and collaborations among learners or engagement of learners' culture.
- On **wisdom in action and functional application of NOIK**, there was little indication of what happens to our daily lives in relation to the topic.

On day 2, during L_2, there was not much difference done from L_1. The environment and the teaching strategy were the same, where T_2 would be more vocal rather than engage learners.

Overall, to ensure the inclusion of NOIK in the NS classroom, one has to understand the context in which learners are operating (Mavuru & Ramnarain, 2018). T_2 was operating in different contexts with his learners.

4.4.2.3 T_2 Post SSI

The researcher interviewed T_2 after the second lesson observation on previous teacher T_1. The interviews were semi-structured, wherein they were asked in a non-sequential form. The SSI was conducted on T_2, and then recorded. Below are the responses.

Question 1 responses

In your view, would you say the overall lesson was a success? Why?

T_2: The lesson was a success, I covered all my lesson objectives, which is to allow learners to know the law of conservation of energy including potential and kinetic energy. I managed to also state examples related to the topics.

The teacher asked questions in terms of satisfaction of the lessons. This in turn gauged if he was aware that integration of IK took place. However, in this case, he responded in abstract terms. He gauged the lesson's success on covering the lesson objectives of the day, which was abstract in the first place. When measuring the overall lesson success, we checked learners' performance based on the assessment. The teacher hence was unsuccessful to draw conclusions of the lesson's success on the right measurement.

Question 2 responses

Are you satisfied with the way you introduced your lesson? Why?

T_2: Yes, I am satisfied; I explained in detail on what law of conservation of energy and added with examples.

The teacher asked questions in terms of satisfaction of the lessons. He measured the satisfaction on wrong grounds. The reason is not clear as to why he was satisfied. When measuring the overall lesson success, we checked learners' performance based on the assessment. The teacher could not draw conclusions of the lessons' success on the right measurements.

Question 3 responses

Are you satisfied with your interaction with the learners? Why?

T_2: No, some learners were withdrawn, they did not share with peers as teaching.

As a facilitator, the teacher was unsuccessful in the aspect of withitness of the classroom. If he was observant and reflective enough, all the aspects of the classroom about interactions in lessons should have been considered, not only the aspect of learners being unable to collaborate or interact. However, the judgement of the response shows that the teacher was not aware whether integration of IK took place or not.

Question 4 responses

Would you say you used the relevant teaching method in this class? Why?

T_2: No, fewer ideas were shared; instead, I should have encouraged my learners to participate.

The teacher gave good reasoning in terms of his lesson observation as a teacher. However, he became abstract in his reasoning. Despite the probing question why, the teaching was not enough. Detailed teaching should also include the factor of assessment as a major check of relevance of teaching methods.

Question 5 responses

If there were some things you could change about your lesson, what would it be and why?

T_2: I would change the following: my teaching focus, where I do less talk and allow my learners to do more talking. Lastly give more assessment during learning.

The teacher was spot on in terms of what his coming lessons should be like. Across all discussions, my observation shows that the teacher was unsuccessful to include the factor of assessment as room for improvement.

Overall discussions

The interviews took place on the second day or after the second lesson, as the researcher administered SSI. The teacher was satisfied. During the administration of SSI, T_2's answers revealed a different perspective. He seemed satisfied with the lessons he conducted. The reasons were that he covered the lesson objectives, which in turn enabled him to substantiate his reasoning. Moreover, I think the aspect of assessment, as part of reasoning was not included.

4.4.3 Case 3 results and analysis

Below is T_3 data on VNOIK questionnaire as administered prior to the lesson observations and post SSI.

4.4.3.1 T_3 VNOIK questionnaire results

Instructions

- From the questionnaire filled, the researcher anticipated the participants' responses in line with the VNOIK rubric above. Below is T_3's anticipated responses in contrast with the rubric. The table represents how T_3's responses were categorised and weighed.

Table 9: T3 categorised and weighed responses

Participant	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Overall score
Teacher 3	UI	I	I	PI	UI	I	I	I	I	I	
Weighing	0	2	2	1	0	2	2	2	2	2	2 (1.5)

- The table above shows that T_3 managed to score an overall average score of 1.5 out of a possible perfect overall average score of 2. Nevertheless, the score indicates that generally the participant has informed views about the nature of Indigenous Knowledge. The participant managed to reflect informed views on seven questions out of a possible ten, which accounts for 70%. On

the other hand, the participant managed to reflect partially informed views in one question out of a possible ten, which accounts for 10%. Lastly, the participant managed to reflect uninformed views in two questions out of a possible ten, which accounts for 20%. Generally, the participant's responses showed that his views are informed as the overall average score is 1.5 with a combination of informed and partially informed scores. Below is a table that shows T_3's responses that caused the above rating or coding.

Table 10: T3 responses and analysis

Question	NS teachers' anticipated responses to questions
1	*"What Indigenous Knowledge is*: In relation to this question, T_3 answered insufficiently by stating, *"Indigenous Knowledge is a knowledge acquired without the aid of Science".* The accuracy involves an uninformed view as Battiste (2002) defined Indigenous Knowledge as knowledge that results from cultural philosophies which is area or societal based. The teacher did not unpack it in more detail.
2	*"Role of experiments?* Regarding the question, T_3 answered: *"They test to validate their knowledge on other people. Example can be how effective the herbs are in someone's body"*. T_3 has showed an informed view as he explained the role of experiments by practitioners by including trial and error. This shows that acts generated by Indigenous Knowledge are derived through experimental observations and tests.
3	*"Natural and unnatural causes?* On this question T_3 showed an informed view as the response was "*They sometimes use supernatural causes, such as a phrase they use God blessed us with rain".* T_3 separated Indigenous Knowledge from spirituality, beliefs and metaphysics. The explanation only suggests that the practitioners of Indigenous

	Knowledge follow certain guidelines.
4	*"Stays the same or changes over time?* On this question T_3 has shown a partially informed view as the response was: *"It does change over time, because of experiences since it has been developed over the experiences of the ancestors who lived centuries ago".* T_3 explained the resilience and yet denies the tentativeness of the Indigenous Knowledge part.
5	*"How is knowledge generated? (Hoodia)* In determining how Indigenous Knowledge is generated, T_3 seemed to be uninformed. The response was "*They came to know by their personal experience with the plant Hoodia gordinii".* Ancestors' knowledge passing was not involved in the answering.
6	*"Used to solve contemporary problems?* T_3 showed Indigenous Knowledge as an initial source of strategies to solve contemporary problems in the response: *"Yes, they can elevate some of the mentioned issues in the society because Indigenous Knowledge is developed through experiences. Other human beings can use some of the experiences for example, when they are sick, they try to heal themselves using herbal medicine".* The teacher eventually agreed that Indigenous Knowledge can solve today's problems.
7	*"Methods and advice?* Methods: As for methods, T_3 clearly outlined a holistic approach which shows how physical systems are examined holistically through response *"The traditional healer will consult his/her ancestors through spirits to find the root of the cause of the problem".*

	Advice/treatment: The participant was unsuccessful to refer proper treatment from the holistic approach used by saying "*He/she will give the advice of that the athlete should notify his/her ancestors before match or competition*" meaning the approaches are the same. The two responses make the teacher to be portrayed as someone who holds an informed view on the question.
8	*"Role of myths* On the role of myths, T_3 scored an informed view by responding: *"Yes, they play significant role in presenting Indigenous Knowledge in various cultures. For example, in Basotho culture, it is not allowed to work the land after the burial of any master in the society".* T_3 clearly stated the importance of myths.
9	*"Reflect social and cultural values?* The teacher holds an informed view on the question as he stated that "*Yes, because through Indigenous Knowledge, the elders install the values and norms in the society from the mostly knowledge systems, like Science, psychology and religion"*. Applied locally or universally? Acknowledgement that Indigenous Knowledge is transferred across communities, cultures and countries have been stated.
10	*"Imagination, creativity* The teacher has shown an informed view as his response was: "*Yes, I believe Indigenous Knowledge practitioners can change or modify their knowledge, because the world always changes, hence they need to adapt to the changing world. Someone who lived 30 years ago may experience something that the current person might not"***.** T_3 have

	shown that Indigenous Knowledge is a true base and a dynamic in continuing to apply creativity and innovation to sustain people's lives.

On the accounts of 70% partially informed and 10% informed and weighing of 1.5, the questions that caused a fall on the overall average score are question 1 and 5 for T_3. Question 1 required the teacher to explain what indigenous (or traditional) knowledge is. T_3 was unsuccessful to explain that Indigenous Knowledge is about ways of knowing about nature and skills by people living in a particular area (local) and society to enhance their everyday lives, or any definition that includes cultural or spiritual beliefs, peoples' history, and co-existence in general. question five asked on how knowledge is generated? The teacher was unsuccessful to acknowledge that Indigenous Knowledge is based or generated through the trial-and-error factor. This includes collective database through observable knowledge as well as repetition and retention. Hence, T_3 could not be scored on a total of 2.0 but scored on an average of 1.5.

4.4.3.2 T_3 $L_{1\&2}$ observation schedule

Table 11:T3 L1&2 observation schedule

T_3 $L_{1\&2}$ observation schedule				
Learning area and topic	**Heat transfer (L_1) Law of conservation of energy (L_2)**			
Teaching method	**Lecture method ($L_{1\&2}$)**			
Number of learners	**47**			
Tenet of the NOIK	**Notes made from what is observed from the teacher (L_1)**		**Notes made from what is observed from the teacher (L_2)**	
	Pedagogical practice that illuminates teachers' views (Notes)	***What actions/strategies/approaches would show us this view? (Notes)***	***Pedagogical practice that illuminates teachers' views (Notes)***	***What actions/strategies/approaches would show us this view? (Notes)***
Empirical and metaphysical NOIK *"Nature is real, partly, or generally tested and observed. Needs-based experimentation. The universe is orderly, metaphysical, and partly predictable"*. *(Agrawal, 1995; Bohensky & Maru, 2011; Le Grange, 2007, Ogunniyi, 2004; Cronje, De Beer & Ankiewicz,*	The teacher did acknowledge that there are aspects in nature to do with energy transfer. He only explained the heat transfer process verbally. Learners listened without interaction; they did not get	The teacher in the lesson included the objects or aids like hot plate and metal rod.	The teacher did acknowledge that for energy to move around it is due to nature. He verbally gave the example of how sound energy travels.	The teacher in the lesson included the objects or aids like radio and vibrating sponge.

2015, p. 323)	chance to add to what teacher has said.			
Resilient yet tentative NOIK *"Indigenous Knowledge has withstood the test of time but is constantly changing as tradition; it is fluid and transformative—linked to people's experiences. The elders' repository of ways of knowing is truth and not to be challenged" (Barnhardt, 2008; Bohensky & Maru, 2011; Senanayake, 2006; Cronje et al., 2015, p. 323).*	The teacher did say that the knowledge of heat transfer dated back in the days. Again, he could not show the resilience or tentativeness of NOIK during his lesson.	The teacher should have acknowledged Indigenous Knowledge dating back from past years.	The teacher did state that the knowledge of heat transfer dated back in the days, but he could not show the resilience or the tentativeness of NOIK during his lesson.	The teacher should have acknowledged the past under energy movement.

Inferential yet intuitive NOIK *"Facts are both tested and experimental observations made. Events have both natural and unnatural causes; metaphysical dimensions are important" (Le Grange, 2007; Ogunniyi, 2004; Senanayake, 2006).*	No experimentation was observed, or tests done for observations.	The teacher was supposed to allow learners to work on experiments and tests so that they come up with their answers.	No experiment was observed, or test done for observations.	The teacher was supposed to allow learners to work on experiments and tests so that they come up with their answers.
Creative and mythical NOIK *"Observations and experimenting are not the only sources of ways of knowing. Human creativity, imagination, metaphors and myths also play a role" (Barnhardt, 2008; De Beer & van Wyk, 2011).*	The teacher did not allow learners to work, at least in groups, but more talking or teaching was done by the teacher, including answering.	The teacher should have been creative with examples of experiments and tests that include metaphors, imaginations, and myths. In addition, the teacher should have allowed learners to be creative around the topic.	The teacher did not allow learners to work, but more talking or teaching was done by the teacher, including answering.	The teacher should have been creative with examples of experiments and tests that include metaphors, imaginations, and myths. In addition, the teacher should have allowed learners to be creative around the topic.
Subjectivity of NOIK *"Indigenous ways of knowing are based on cosmology and interwoven with culture and the spiritual. The elders can be*	Again, The teacher did not acknowledge the past practice with regard to the topic. None of the	IK was supposed to be cited from the ancient times with examples like the heat transfers in the mines.	Again, The teacher did not acknowledge the past practice with regard to the topic. None of the examples was even given to the learners.	IK was supposed to be cited from the ancient times with examples like the heat transfers in the mines.

influenced by prior ways of knowing and beliefs" (Aikenhead & Ogawa, 2007; Ogunniyi, 2004)	examples was even given to the learners.			
Social, collaborative, and cultural NOIK *"Indigenous Knowledge is situated in cultural tradition and within a certain historical–political context. It is the consequence of activities connected to everyday life in the natural environment of a group of people. It does not focus on the individual, but on the group and sharing. Indigenous Knowledge is locally rooted and ecologically based. It is generated at a specific place by people of that place. Indigenous Knowledge is orally transmitted*	Daily interactions acknowledgements were made verbally, specifically on the skills learners practice every day like cooking. Multiple examples were not given though.	The teacher supposed to state multiple examples on daily skills that learners practice. Also, to explain how heat transfer occurs in each example as stated.	Daily interactions acknowledgements were made verbally, specifically on the skills learners practice every day like cooking. Multiple examples were not given though.	The teacher was supposed to state multiple examples on daily skills that learners practice, and to explain how heat transfer occurs in each example as stated.

Generalisations are relative within a certain context and can be shared among communities and beyond" (Agrawal, 1995, Barnhardt, 2008; Bohensky & Maru, 2011).				
Wisdom in action and NOIK *"Indigenous Knowledge is generated by practical engagement in everyday life through trial-and-error experiences. Repetition, imitation, and ceremonies are methods to aid retention and reinforce ideas. New ideas are rigorously tested in the 'laboratory of survival" (Senanayake,2006, p. 87; Aikenhead & Ogawa, 2007; Barnhardt, 2008; De Beer & van Wyk, 2011).*	The teacher not innovative enough, instead he kept on explaining many aspects of the lesson. The lesson was teacher-centred.	The teacher was supposed to be more innovative and allow learners to experiment and do tests related to the topic.	The teacher was supposed to be innovative; instead he kept on explaining things verbally. The lesson was teacher- centred.	The teacher was supposed to be innovative and allow learners to experiment and do tests related to the topic.

Functional application and NOIK *"Indigenous Knowledge is concerned with what and why things happen in nature, but also with what ought to happen. Emphasis is on functional application and skills. Indigenous Knowledge is concerned with the everyday lives of people rather than facts, theories and laws" (Agrawal, 1995, Aikenhead & Ogawa, 2007).*	The examples did not give learners applications and skills as they were not stated enough.	The teacher was supposed to give more examples related to the topic that applies to everyday life.	The examples did not give learners applications and skills as they were not stated enough.	The teacher was supposed to give more examples related to the topic that applies to everyday life context.

Holistic approach of Indigenous Knowledge *"Indigenous Knowledge is 'a conglomeration of knowledge systems' (Ogunniyi, 2007a, p. 965) including Science, religion, psychology, and other fields. Problems are solved in a holistic manner addressing all the smaller parts with no boundaries with the metaphysical world" (Agrawal, 1995; Senanayake, 2006).*	The teacher did not trigger learners' curiosity, otherwise they would have come up with many examples related to the topic and others would be ancient.	The teacher ought to trigger learners' curiosity so that they come with many examples related to the topic.	The teacher did not trigger learners' curiosity, otherwise they would have come up with many examples related to the topic and others would be ancient.	The teacher ought to have triggered learners' curiosity so that they come with many examples related to the topic.

Observation schedule discussions

Before filling in the observation schedule, the researcher observed that learners were quiet. T_3 seemed to be more interested in teaching L_1, but learners were reserved. T_3 introduced the lesson nevertheless. These are the observations made in respect to L_1 in respect of the observation schedule tenets of NOIK.

- On **Empirical and metaphysical NOIK**, pedagogical practices that illuminate T_3 were clear. However, he did not show or acknowledge the mother-nature in the introduction lesson and during the lesson. This includes the teacher's actions.
- On **the resilient and tentative NOIK**, the pedagogical practice that illuminates T_3 was even clearer. The teacher did not engage learners' traditional experiences. The only routine done throughout the lesson was to involve western explanations using the textbook.
- On **inferential and intuitive NOIK**, T_3 was unsuccessful to observe learners' traditional knowledge by eliciting it. No tests and experiments were done.
- On **creative and mythical NOIK**, T_3 could not engage the learners in a way that would intrigue them to be creative. This means that the teacher was also uncreative in that sense. During the lesson, no myth was said to build up the knowledge.
- On **subjectivity of NOIK**, although T_3 was verbal, he could not show subjectivity during the lesson. The subjectivity could have shown what different scientists say about energy transfer in an open and closed environment.
- On **social, collaborative, and cultural NOIK**, the teacher could not do more to engage the learners. From the time we entered the class and during the lesson, the learners were way distant and reserved. There were no social interactions, collaborations, or engagement among learners about their culture.
- On **wisdom in action and functional application of NOIK**, there was less indication of what happens to our daily lives in relation to the topic.

On day 2, during L_2, there was not much difference done from L_1. The environment and teaching strategy were the same, where T_3 was rather more vocal rather than engage learners.

Overall, to ensure the inclusion of NOIK in the NS classroom, one has to understand the context in which learners are operating (Mavuru & Ramnarain, 2018). T_3 was operating in a different context with his learners.

4.4.3.3 T_3 Post SSI

After the second lesson observation with previous teachers $T_{1\&2,}$ the researcher interviewed T_3. The interviews were semi-structured and asked in a non-sequential form. The SSI was conducted on T_3, and then recorded. Below are the responses.

Question 1 responses

In your view, would you say the overall lesson was a success? Why?

T_3: Yes, I managed to present my lesson successfully and assess in time.

The teacher's response in terms of satisfaction about lessons had been asked. This in turn gauged if the teacher aware that integration of IK took place. The teacher in this case responded positively. He gauged the lesson's success on assessment, which gave a good impression about the lessons. When measuring the overall lesson success, we checked learners' performance based on the assessment. The teacher hence drew conclusions of the lesson's success on the right measurement.

Question 2 responses

Are you satisfied with the way you introduced your lesson? Why?

T_3: Yes, due to time, I prepared lesson on a rush, but I managed to show learners that energy is not really lost.

The teacher asked questions in terms of satisfaction of the lessons. This in turn gauged if he was aware that integration of IK took place. However, in this case, he responded moderately. He gauged the lesson's introduction as success on her way

of teaching. Nothing was said that involved how learners reacted on the introduction made.

Question 3 responses

Are you satisfied with your interaction with the learners? Why?

T_3: No, I was unsuccessful to come up with material for demonstration.

As a facilitator, the teacher was a bit unsuccessful in the aspect of withitness of the classroom. If he was observant and reflective enough, all the aspects of interaction in the classroom lessons should have been considered, not only the aspect of learners' ability to collaborate in a question-and-answer session. The teacher was a bit unsuccessful to provide details of all the aspects of the lessons he has been including in assessment.

Question 4 responses

Would you say you used the relevant teaching method in this class? Why?

T_3: Partly no, I mean somewhere it worked (advantages), somewhere it did not (disadvantages). It worked in the introduction, while during the lesson it lacked.

Again, the teacher became abstract in his reasoning. Despite the probing question why, the teaching was not enough. Details should also include the factor of assessment as a major check of relevance of teaching methods.

Question 5 responses

If there were some things you could change about your lesson, what would it be and why?

T_3: I would change my teaching method and add to my teaching aids.

The factor of learners' interruption simply shows that the lesson lacked somewhere. Across all discussions, my observation shows that the teacher was unsuccessful to include the factor of assessment as room for improvement. He was unsuccessful in his reasoning to include assessment as a major factor.

Overall discussions

The interviews took place on the second day or after the second lesson. As the researcher administered SSI, he was satisfied. During the administration of SSI, T_3's

answers revealed different perspectives. T_3 seemed most satisfied with the lessons he conducted. The reasons were that some learners raised hands, channelling T_3 to be convinced that the lesson was a success. However, I think the aspect of assessment as part of reasoning was left out.

4.4.4 Case 4 results and analysis

Below is T_4 data on the VNOIK questionnaire as administered prior to the lesson observations and post SSI.

4.4.4.1 T_4 VNOIK questionnaire results

Instructions

- From the questionnaire, the researcher anticipated the participants' responses in line with the VNOIK rubric above. Below is T_4's anticipated responses in contrast with the rubric. The table represents how T_4's responses were categorised and weighed.

Table 12: T4 categorised and weighed responses

Participant	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Overall score**
Teacher 4	I	I	I	I	PI	I	PI	I	I	I	
Weighing	2	2	2	2	1	2	1	2	2	2	2 (1.8)

- The table above shows that T_4 managed to score an overall average score of 1.8 out of a possible perfect overall average score of 2. Yet, the score shows that generally the participant has, no doubt, informed views about the nature of Indigenous Knowledge. The participant managed to reflect only informed views on eight questions out of a possible ten, which accounts for 80%, and partially informed views on two questions out of a possible ten, which accounts for 20%. This makes T4 excellently informed about NOIK.

Table 13: T4 responses and analysis

Question	**NS teachers' anticipated responses to questions**
1	*"What Indigenous Knowledge is*:

	In relation to this question, T_4 managed to answer appropriately by stating *"Indigenous Knowledge according to my understanding, is the knowledge, skills acquired simply by virtue of societal beliefs, it is rooted on historical experiences, and is transmitted by the elderly in the society to the young ones. It is not universal since is more based on diverse ideologies. Such as where a person is situated, one's culture".* The accuracy involves an informed view as Battiste (2002) defined Indigenous Knowledge as knowledge that results from cultural philosophies which are area or societal based.
2	*"Role of experiments?* Regarding the question, the answer by T_4 *"Focusing on traditional healers and herbalists, mostly of them engage in trial- error practice in their huts to test some of their herbs with the guidance of most experienced healers"*. T_4 has showed an informed view as he explained the role of experiments by practitioners by including trial and error. This has shown that acts generated by Indigenous Knowledge are derived through experimental observations and tests.
3	*"Natural and unnatural causes?* On this question, T_4 showed an uninformed view as the response was: "*The nature of Indigenous Knowledge embraces the "Sometimes elders do use supernatural explanation, for instances how they explain the issue of albinism. Elderly people believe that kids born with albinisms are associated with witchcraft, which I view as being farfetched where Science is concerned, albinism is based on genetics".* T_4 did separate Indigenous Knowledge from spirituality, beliefs and metaphysics. The explanation suggested that the practitioners of Indigenous Knowledge follow certain guidelines.
4	*"Stays the same or changes over time?*

	On this question, T_4 has shown an informed view as the response was: "*Knowledge is tentative by nature, meaning it evolves from generation to generation. Indigenous Knowledge is based on society, culture, history, and those factors get modified with centuries. The way the elderly and young one's view and interpret nature is different".* T_4 explained in detail the resilience and tentativeness of Indigenous Knowledge.
5	*"How is knowledge generated? (Hoodia)* In determining how Indigenous Knowledge is generated, T_4 seemed to be partially informed. The response was "*It is rooted on history, ancient people used to explore herbs, I would say they were risk-takers, and what they found working, they passed the knowledge to younger generations".* The only aspect on the explanation is the aspect of repetition that assists in retention. Ancestors' knowledge passing was not involved.
6	*"Used to solve contemporary problems?* T_4 has shown Indigenous Knowledge as an initial source of strategies to solve contemporary problems on the response: *"Only in a low scale though, it can work. For instances on hunger and poverty, indigenously people used to practice farming which assisted in food security on a lower scale (few households). Thus, if sufficient knowledge is passed to younger generations, hunger can be a thing of the past. Yet such is also influenced by climatic conditions".* The teacher is eventually agreeing that Indigenous Knowledge can solve today's problems, hence showing an informed view.
7	*"Methods and advice?* Methods: As for methods, T_4 clearly outlined a holistic approach which shows how physical systems are examined holistically through the response: *"To diagnose the problem, the healer will consult (connect with)*

	ancestors be it utilising "bones" or any other median tool used to get directives as to if witchcraft was practice on the athlete or its natural course". Advice/treatment: The participant was unsuccessful to refer proper treatment from a holistic approach used by saying: "*Upon engaging with the ancestors, the healer will be informed on remedial actions (be it provide the athlete with herbs or order him/her to perform some ritual to surpass the effects)"* meaning the approaches are mixed. The two responses make the teacher to be portrayed as someone who hold a partially informed view on the question.
8	*"Role of myths* On the role of myths T_4 scored an informed view as his response was: *"The authenticity of Indigenous Knowledge is based on a historical belief, and it goes on unquestioned, thus some of the knowledge passed to young generations can be myths, yet young generation will still acquire the knowledge"* clearly indicating the importance of myths with examples.
9	*"Reflect social and cultural values?* The teacher holds an informed view on the question as he stated: "*I profusely believe that, as I indicated in question 8, the knowledge I got was based on my culture, society at large.* *Chinese, mostly they eat food from the pots they cook from*" this could be related to their knowledge systems, like Science, psychology and religion. Applied locally or universally? Acknowledgement that Indigenous Knowledge is transferred across communities, cultures and countries have been stated.

10	*"Imagination, creativity* The teacher has shown an informed view as his response was: "*I believe that knowledge is tentative, it evolves with time, generations. Indigenous Knowledge cannot be completely changed yet it can be altered to meet the needs of the current generation",* which shows that Indigenous Knowledge is a true base and a dynamic in continuing to apply creativity and innovation to sustain people's lives.

T_4 did not provide more details in Q_5 and Q_7. Where a proper and deep explanation was needed, the teacher gave abstract explanations. In Q_5, the teacher explained the part of repetition and retention. The aspect that lacked is observation as the main key and ancestral acknowledgement. Apart from the two aspects, the responses are way close to accuracy. In Q_7, the teacher did not explain enough and was unsuccessful to refer to an example of proper indigenous treatment from a given scenario. He only spoke about *"remedial actions"* which not everybody will understand what was meant. At least more elaboration was needed.

4.4.4.2 T_4 $L_{1\&2}$ observation sched

Table 14:T4 L1&2 observation schedule

T_4 $L_{1\&2}$ observation schedule				
Learning area and topic	**Law of conservation of energy (L_1) Heat transfer (L_2)**			
Teaching method	**Demonstration method ($L_{1\&2}$)**			
Number of learners	**45**			
Tenet of the NOIK	**Notes made from what is observed from the teacher**			
	Notes made from what is observed from the teacher (L_1)		**Notes made from what is observed from the teacher (L_2)**	
	Pedagogical practice that illuminates teachers' views (Notes)	***What actions/strategies/approaches would show us this view? (Notes)***	***Pedagogical practice that illuminates teachers' views (Notes)***	***What actions/strategies/ approaches would show us this view? (Notes)***
Empirical and metaphysical NOIK *"Nature is real, partly, or generally tested and observed. Needs-based experimentation. The universe is orderly, metaphysical, and partly predictable"*. *(*Agrawal*, 1995; Bohensky & Maru, 2011; Le Grange, 2007, Ogunniyi, 2004; Cronje, De Beer & Ankiewicz, 2015, p. 323)*	The teacher did acknowledge that for energy to move around, it is due to nature. He verbally gave the example of how sound energy travels.	Learners should be given more chance to give more examples to indigenous learners.	The teacher did not acknowledge that there are aspects in nature to do with energy transfer. He only explained the heat transfer process verbally. Learners listened without interaction; they did not get a chance to add to what the teacher said.	The teacher included the objects or aids like hot plate and metal rod in the lesson.

Resilient yet tentative NOIK *"Indigenous Knowledge has withstood the test of time but is constantly changing as tradition; it is fluid and transformative—linked to people's experiences. The elders' repository of ways of knowing is truth and not to be challenged" (Barnhardt, 2008; Bohensky & Maru, 2011; Senanayake, 2006; Cronje et al., 2015, p. 323).*	The teacher did state that the knowledge of energy transfers or movement dated back in the days. And she could show the resilience or tentativeness of NOIK during her lesson.		The teacher did state that the knowledge of heat transfer dated back in the days. Again, he could not show the resilience or tentativeness of NOIK during his lesson.	
Inferential yet intuitive NOIK *"Facts are both tested and experimental observations made. Events have both natural and unnatural causes; metaphysical dimensions are important" (Le Grange, 2007; Ogunniyi, 2004; Senanayake, 2006).*	The teacher used a metal rod and a hot plate in a way of demonstration. This was her way of performing an experiment and observation.	The teacher was supposed to allow learners to work on experiments and tests so that they come up with their answers.	Experimentation was observed through the demonstration of heat movement on a metal rod, or tests done for observations.	The teacher was supposed to allow learners to work on an experiment and test so that they come up with their answers.
Creative and mythical NOIK ***"****Observations and experimenting are not the only sources of ways of knowing. Human creativity, imagination, metaphors, and myths also play a role" (Barnhardt,*	Teacher did allow learners to observe through her demonstration, but more talking or teaching was done by	The teacher should have been creative with examples of experiments and tests that include metaphors, imaginations, and myths, and allow	The teacher did not allow learners to work, but more talking or teaching was done by the teacher, including answering.	The teacher should have been creative with examples of experiments and tests that include metaphors,

2008; De Beer & van Wyk, 2011).	the teacher, including answering.	learners to be creative around the topic.		imaginations, and myths, and allow learners to be creative around the topic.
Subjectivity of NOIK *"Indigenous ways of knowing are based on cosmology and interwoven with culture and the spiritual. The elders can be influenced by prior ways of knowing and beliefs" (Aikenhead & Ogawa, 2007; Ogunniyi, 2004).*	Teacher showed more origin. Again, teacher did acknowledge the past practice with regards to the topic. Examples were even given to the learners.		Again, teacher showed more originality. Again, teacher did acknowledge the past practice in regard to the topic. Examples were even given to the learners.	
Social, collaborative and cultural NOIK *"Indigenous Knowledge is situated in cultural tradition and within a certain historical–political context. It is the consequence of activities connected to everyday life in the natural environment of a group of people. It does not focus on the individual, but on the group and sharing. Indigenous Knowledge is locally rooted and ecologically based. It is generated at a specific place by people of that place.*	Daily interactions and acknowledgements were made verbally, specifically on the skills learners practice every day like cooking. Multiple examples were not given though.	The teacher was supposed to state multiple examples on daily skills that learners practice and explain how heat transfer occurs in each example as stated.	Daily interactions and acknowledgements were made verbally, specifically on the skills learners practice every day like cooking. Multiple examples were not given though.	The teacher was supposed to state multiple examples on daily skills that learners practice and explain how heat transfer occurs in each example as stated.

Indigenous Knowledge is orally transmitted Generalisations are relative within a certain context and can be shared among communities and beyond" (Agrawal, 1995, Barnhardt, 2008; Bohensky & Maru, 2011).				
Wisdom in action and NOIK *"Indigenous Knowledge is generated by practical engagement in everyday life through trial-and-error experiences. Repetition, imitation, and ceremonies are methods to aid retention and reinforce ideas. New ideas are rigorously tested in the 'laboratory of survival" (Senanayake, 2006, p. 87; Aikenhead & Ogawa, 2007; Barnhardt, 2008; De Beer & van Wyk, 2011).*	The teacher was innovative through experimentation. Though, the lesson was teacher-centred.	The teacher was supposed to be innovative and allow learners to experiment and do tests by themselves in anyway related to the topic.	The teacher was innovative, instead he kept on explaining many aspects of the lesson. The lesson was teacher-centred.	The teacher was supposed to be innovative and allow learners to experiment and do tests in anyway related to the topic.
Functional application and NOIK *"Indigenous Knowledge is concerned with what and why things happen in nature, but also with what ought to happen. Emphasis is on functional application and skills. Indigenous Knowledge is concerned with the everyday lives of people rath Problems*	The examples did give learners applications and skills as they were stated enough.		The examples did give learners applications and skills as they were stated enough.	

are solved in a holistic manner addressing all the smaller parts with no boundaries with the metaphysical world" (Agrawal, 1995; Senanayake, 2006). than facts, theories and laws" (Agrawal, 1995, Aikenhead & Ogawa, 2007).				
Holistic approach of Indigenous Knowledge *"Indigenous Knowledge is 'a conglomeration of knowledge systems' (Ogunniyi, 2007a, p. 965) including Science, religion, psychology and other fields. Problems are solved in a holistic manner addressing all the smaller parts with no boundaries with the metaphysical world" (Agrawal, 1995; Senanayake, 2006).*	The teacher did not trigger learners' curiosity. Learners would have come up with many examples rather than the one she was demonstrating.	The teacher ought to have triggered learners' curiosity so that they come up with many examples related to the topic.	The teacher did not trigger learners' curiosity, otherwise learners would have come with many examples related to the topic and others would be ancient.	The teacher ought to have triggered learners' curiosity, so that they come up with many examples related to the topic.

Observation schedule discussions

Before filling in the observation schedule, the researcher observed that learners were quiet. T_4 seemed to be more interested in teaching L_1, but learners were more reserved. T_4 introduced the lesson nevertheless. These are the observations made in respect to L_1 in respect to the observation schedule tenets of NOIK.

- On **Empirical and metaphysical NOIK**, pedagogical practices that illuminate T_4 were clear. However, he did not show or acknowledge the mother-nature in the introductory lesson and during the lesson. This includes the teacher's actions.
- On **the resilient and tentative NOIK**, pedagogical practices that illuminate T_4 were even clearer. The teacher did not engage learners' traditional experiences. The only routine done throughout the lesson was to involve western explanations using the textbook.
- On **inferential and intuitive NOIK**, T_4 was a bit unsuccessful to observe the learners' traditional knowledge by eliciting it. No tests or experiments were done.
- On **creative and mythical NOIK**, T_4 could not engage the learners in a way that would intrigue them to be creative. This means that the teacher was also uncreative in that sense. During the lesson, no myth was said to build up the knowledge.
- On **the subjectivity of NOIK**, although T_4 was verbal, he could not show subjectivity during the lesson. The subjectivity could have been shown what different scientists say about energy transfer in open and closed environment.
- On **social, collaborative and cultural NOIK**, the teacher was a bit unsuccessful. From the time we entered the class and during the lesson, the learners were distant and reserved. There were no social interactions, collaborations or engagement among learners of their culture.
- On **wisdom in action and functional application of NOIK**, there was little indication of what happens to our daily lives in relation to the topic.

On day 2, during L_2, there was not much difference done from L_1. The environment and teaching strategy were the same, where T_4 was rather more vocal than engage learners.

Overall, for the inclusion of NOIK in the NS classroom, one has to understand the context in which learners are operating (Mavuru & Ramnarain, 2018). T_4 was operating in different contexts with his learners.

4.4.4.3 T_4 Post SSI

After the second lesson observation, the researcher like with previous teachers $T_{1,2\ \&3}$, interviewed T_4. The interviews were semi-structured and asked in a non-sequential form. The SSI was conducted on T_4, and then recorded. Below are the responses.

Question 1 responses

In your view, would you say the overall lesson was a success? Why?

T_4: Yes, the video play I was using was helpful in demonstrating the flow of energy in the system.

The teacher asked questions in terms of satisfaction of the lessons. This in turn gauged if he was aware that integration of IK took place. However, in this case, he responded in abstract terms. He gauged lesson's success on learners' responses to the introduction, which was wrong in the first place. When measuring the overall lesson's success, we checked their performance based on the assessment. The teacher hence was unsuccessful to draw conclusions of the lesson's success on the right measurement.

Question 2 responses

Are you satisfied with the way you introduced your lesson? Why?

T_4: No, at first learners were not interested in the video play.

The teacher asked questions in terms of satisfaction of the lessons. This in turn gauged if he was aware that integration of IK took place. However, in this case, he

responded in abstract terms. He gauged the lesson's success on learners' responses to the introduction, which was wrong in the first place. When measuring the overall the lesson's success, we checked learners' performance based on the assessment. The teacher was a bit unsuccessful to draw conclusions of the lesson's success on the right measurement.

Question 3 responses

Are you satisfied with your interaction with the learners? Why?

T_4: No, they did not interact, rather they were interested more on the video play.

As a facilitator, the teacher was unsuccessful in the aspect of withitness of the classroom. If he was observant and reflective enough, all the aspects of the classroom about interactions in lessons should have been considered, not only the aspect of learners' ability to collaborate in a question-and-answer session. The teacher was a bit unsuccessful to provide more details of all the aspects of the lessons he had, including assessment.

Question 4 responses

Would you say you used the relevant teaching method in this class? Why?

T_4: Yes, there was a poor planning, but the method was correct.

Again, the teacher became abstract in his reasoning. Despite the probing question why, the teacher's reasoning was not enough. Details should also include the factor of assessment as a major check of the relevance of teaching methods.

Question 5 responses

If there were some things you could change about your lesson, what would it be and why?

T_4: I would change the way I planned my lessons. I would plan the whole lesson digitally.

The factor of learners' interruption simply shows that the lesson lacked somewhere. Across all discussions, my observation shows that the teacher could not include the factor of assessment as room for improvement. The teacher was unsuccessful in reasoning to include assessment as a major factor.

Overall discussions

The interviews took place on the second day or after the second lesson. As the researcher administered SSI, he seemed not satisfied. During the administration of SSI, T_6's answers revealed a different perspective from other participants. T_6 seemed mostly not satisfied with the lessons he conducted as per responses. The reasons were that some of the learners raised their hands, channelling T_6 to be convinced that the lesson was a success. However, I think the aspect of assessment as part of reasoning was left out.

4.4.5 Case 5 results and analysis

Below is T_5 data on VNOIK questionnaire as administered prior to the lesson observations and post SSI.

4.4.5.1 T_5 VNOIK questionnaire results

Instructions

- From the questionnaire filled, the researcher has anticipated the participants' responses in line with the VNOIK rubric above. Below is T_5 anticipated responses in contrast with the rubric. The table below represents how T_5 responses were categorised and weighed.

Table 15: T5 categorised and weighed responses

Participant	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Overall score**
Teacher 5	PI	UI	I	PI	UI	UI	PI	UI	UI	UI	
Weighing	1	0	2	1	0	0	1	0	0	0	1 (0.5)

The table above shows that T_5 managed to score an overall average score of 0.5 out of a possible perfect overall average score of 2. Moreover, the score shows that generally the participant has uninformed views about the nature of Indigenous Knowledge. The participant managed to reflect only informed views on one question out of a possible ten which accounts for 10%. And partially informed views on three questions out of a possible ten, which accounts for 30%. And uniformed views on six questions which statute 60% of the score. This makes T_5

undeniably uninformed about NOIK. Below is T_5 responses to support the overall average score provided above.

Table 16: T5 responses and analysis

Question	NS teachers' anticipated responses to questions
1	*"What Indigenous Knowledge is*: In relation to this question, T_5 managed to answer semi-appropriately by stating *"Indigenous Knowledge is passed from one generation to the next in a form of oral tradition. It is different from western knowledge because the western knowledge is recorded or written down for future references and it is included in the education system".* The accuracy involves partially informed view as Battiste (2002) defines Indigenous Knowledge as a knowledge that results from cultural philosophies which are area or societal based. The tenets of NOIK were not fully engaged on the response.
2	*"Role of experiments?* Regarding the question, the answer by T_5 was: *"No, Herbalist and traditional healers are spiritual beings, they believe in the visions and dreams…"* T_5 showed an uninformed view. The answer was no to practitioners involve experiments.
3	*"Natural and unnatural causes?* On this question, T_5 showed an informed view as the response was: "*Elders and traditional healers don't believe in Science. So, whenever lightning occurs, they believe that something supernatural is happening in their spiritual dimension. Example can be that they believe that lightning can be bought from another healer who have the gift to control lightning".* T_5 could separate Indigenous Knowledge from spirituality, beliefs and metaphysics. The explanation did suggest that the practitioners of Indigenous Knowledge follow certain guidelines.
4	*"Stays the same or changes over time?*

	On this question T_5 showed a partially informed view as the response was: *"It stays the same because it changes or if additional information is added it loses its authenticity and value".* T_5 explained semi resilience and tentativeness of Indigenous Knowledge on the response.
5	*"How is knowledge generated? (Hoodia)* In determining how Indigenous Knowledge is generated, T_5 seemed to be uninformed. The response was "*Through Indigenous Knowledge. It was passed down to them from their ancestors who were hunters".* The only aspect on the explanation is the aspect of repetition that assists in retention. The passing of ancestors' knowledge was not involved.
6	*"Used to solve contemporary problems?* T_5 did not show Indigenous Knowledge as an initial source of strategies to solve contemporary problems on the response: *"Indigenous Knowledge cannot eradicate poverty because a similar strategy was used once but was implicated and it didn't work because of corruption and lazy society that we have today".* The teacher did not fully agree that Indigenous Knowledge can solve today's problems, classifying the teacher as uninformed.
7	*"Methods and advice?* Methods: As for methods, T_5 clearly outlined a holistic approach which shows how physical systems are examined holistically through the response: *"The traditional healer should first do consultation with ancestors to diagnose the athlete. The healer should also give the herbs that could help the athlete with the issues he is facing".* Advice/treatment: The participant could not refer proper treatment from the holistic

	approach used by saying: "*Herbal medication*". The treatment was not given in detail. The two responses make the teacher to be portrayed as someone who hold a partially informed view on the question.
8	*"Role of myths.* On the role of myths T_5 scored an uninformed view as his response: *"Indigenous Knowledge is "No because they only mislead the information from the past generations. Example is when we don't know how the elders handled the epilepsy disease, because of myths that have been told".* This clearly demolishes the use of myths.
9	*"Reflect social and cultural values?* The teacher holds an uninformed view on the question as he stated that "*I don't believe that Indigenous Knowledge can be used and reflects the social and cultural values …"* Applied locally or universally? Acknowledgement that Indigenous Knowledge is transferred across communities, cultures and countries has not been stated without examples.
10	*"Imagination, creativity* The teacher has shown uninformed view as his response "*Indigenous Knowledge cannot be changed…"* shows that Indigenous Knowledge is not a true base and a dynamic in continuing to apply creativity and innovation to sustain people's lives as the example given did not show any creativity or imagination.

- T_5's responses are mostly abstract explanations. The teacher could not provide in-depth and more detailed explanations. In most cases, T_5 could not include any related wording on their response based the given question in the questionnaire. T_5 mostly demolished the use of myths across Indigenous Knowledge and could not state with examples in his response that Indigenous

Knowledge is transferred across communities, cultures and countries. Hence, T_5 is rated uninformed about NOIK with a percent of 60 and a weighting of 0.5.

4.4.5.2 T_5 $L_{1\&2}$ observation schedule

Table 17:T5 L1&2 observation schedule

T_5 $L_{1\&2}$ observation schedule				
Learning area and topic	**Potential and kinetic energy (L_1) Heat transfer (L_2)**			
Teaching method	**Peer learning ($L_{1\&2}$)**			
Number of learners	**41**			
Tenet of the NOIK	**Notes made from what is observed from the teacher**			
	Notes made from what is observed from the teacher (L_1)		**Notes made from what is observed from the teacher (L_2)**	
	Pedagogical practice that illuminates teachers' views (Notes)	***What actions/strategies /approaches would show us this view? (Notes)***	***Pedagogical practice that illuminates teachers' views (Notes)***	***What actions/strategies/approaches would show us this view? (Notes)***
Empirical and metaphysical NOIK *"Nature is real, partly, or generally tested and observed. Needs-based experimentation. The universe is orderly, metaphysical, and partly predictable". (Agrawal, 1995; Bohensky & Maru, 2011; Le Grange, 2007, Ogunniyi, 2004; Cronje, De Beer & Ankiewicz, 2015, p. 323)*	The teacher did not acknowledge that there are aspects in nature to do with energies presented. He only explained the terms kinetic and potential energy.	The teacher did not show or acknowledge nature, no experimentation was done to substantiate the knowledge given.	The teacher did not acknowledge that there are aspects in nature to do with energy transfer. He only explained the heat transfer process verbally. Learners listened without interaction; they did not get a chance to add to what teacher said.	The teacher included the objects or aids like hot plate and metal rod in the lesson.

Resilient yet tentative NOIK *"Indigenous Knowledge has withstood the test of time but is constantly changing as tradition; it is fluid and transformative linked to people's experiences. The elders' repository of ways of knowing is truth and not to be challenged" (Barnhardt, 2008; Bohensky & Maru, 2011; Senanayake, 2006; Cronje et al., 2015, p. 323).*	The teacher did not include history like in sports as per topic. Again, he could not show the resilient or tentativeness of NOIK during his lesson.	The teacher should have acknowledged the past under potential and kinetic energies.	The teacher did not state that the knowledge of heat transfer dated back in the days. Again, he could not show the resilient or tentativeness of NOIK during his lesson.	The teacher should have acknowledged the past under heat transfer.
Inferential yet intuitive NOIK *"Facts are both tested and experimental observations made. Events have both natural and unnatural causes; metaphysical dimensions are important" (Le Grange, 2007; Ogunniyi, 2004; Senanayake, 2006).*	No experimentation was observed, or tests done for observations.	The teacher was supposed to allow learners to work on experiments and tests so that they come up with their answers.	Experimentation was done by learners through metals and hot plate.	The teacher was supposed to allow learners to work more and come up with their answers.
Creative and mythical NOIK ***"****Observations and experimenting are not the only sources of ways of knowing. Human creativity, imagination, metaphors, and myths also play a role"*	The teacher did not allow learners to work, but more talking or teaching was done by the teacher, including	The teacher should have been creative with examples of experiments and tests that includes metaphors,	The teacher did not allow learners to work enough, but more talking or teaching was done by the teacher, including answering.	The teacher should have been creative with examples during experiments and tests and includes metaphors, imaginations, and myths. In

(Barnhardt, 2008; De Beer & van Wyk, 2011).	answering.	imaginations, and myths. In addition, the teacher should have allowed learners to be creative around the topic.		addition, the teacher should have allowed learners to be creative around the topic.
Subjectivity of NOIK *"Indigenous ways of knowing are based on cosmology and interwoven with culture and the spiritual. The elders can be influenced by prior ways of knowing and beliefs" (Aikenhead & Ogawa, 2007; Ogunniyi, 2004)*	Again, the teacher did not acknowledge the history, culture or spirituality upon the topic.	IK was supposed to be cited from the ancient times with examples like the heat transfers in the mines.	Again, the teacher did not acknowledge the past practice with regards to the topic. None of the examples was even given to the learners.	IK was supposed to be cited from the ancient times with examples like the heat transfers in the mines.
Social, collaborative, and cultural NOIK *"Indigenous Knowledge is situated in cultural tradition and within a certain historical–political context. It is the consequence of activities connected to everyday life in the natural environment of a group of people. It does not focus on the individual, but on the*	Daily interactions and acknowledgements were not made, specifically on the skills learners practice every day like cooking. Multiple examples.	The teacher was supposed to state multiple examples on daily skills that learners practice. There was a need to explain how heat transfer occurs in each example as	Daily interactions acknowledgements were made verbally, specifically on the skills learners practice every day like cooking. Multiple examples were not given though.	The teacher was supposed to state multiple examples on daily skills that learners practice. The, explain how heat transfer occurs in each example as stated.

group and sharing. Indigenous Knowledge is locally rooted and ecologically based. It is generated at a specific place by people of that place. Indigenous Knowledge is orally transmitted Generalisations are relative within a certain context and can be shared among communities and beyond" (Agrawal, 1995, Barnhardt, 2008; Bohensky & Maru, 2011).	were not given though.	stated.		
Wisdom in action and NOIK *"Indigenous Knowledge is generated by practical engagement in everyday life through trial-and-error experiences. Repetition, imitation, and ceremonies are methods to aid retention and reinforce ideas. New ideas are rigorously tested in the 'laboratory of survival" (Senanayake, 2006, p. 87; Aikenhead & Ogawa, 2007; Barnhardt, 2008; De Beer & van Wyk, 2011).*	The teacher as not innovative enough, instead he kept on explaining many aspects of the lesson. The lesson was teacher-centred.	The teacher was supposed to be innovative and allow learners to experiment and do tests in anyway related to the topic.	The teacher was less innovative, instead he kept on explaining many aspects of the lesson.	The teacher was supposed to be innovative and allow learners to experiment more and do tests in anyway related to the topic and come up with their own answers.
Functional application and NOIK *"Indigenous Knowledge is concerned with what and why things happen in nature,*	The examples did not give learners applications and skills as they were	The teacher was supposed to give more examples related to the topic	The examples did not give learners applications and skills as they were not stated enough.	The teacher was supposed to give more examples related to the topic that apply to the everyday life

but also with what ought to happen. Emphasis is on functional application and skills. Indigenous Knowledge is concerned with the everyday lives of people rather than facts, theories, and laws" (Agrawal, 1995, Aikenhead & Ogawa, 2007).	not stated enough.	that apply to the everyday life context.		context.
Holistic approach of Indigenous Knowledge *"Indigenous Knowledge is 'a conglomeration of knowledge systems' (Ogunniyi, 2007a, p. 965) including Science, religion, psychology and other fields. Problems are solved in a holistic manner addressing all the smaller parts with no boundaries with the metaphysical world" (Agrawal, 1995; Senanayake, 2006).*	The teacher did not trigger learners' curiosity, otherwise learners would have come up with many examples related to the topic and others would be ancient.	The teacher ought to have triggered learners' curiosity, so that they come with many examples related to the topic.	The teacher did not trigger learners' curiosity, otherwise learners would have come up with many examples related to the topic and others would be ancient.	The teacher ought to trigger learners' curiosity so that they come up with many examples related to the topic.

Observation schedule discussions

Before filling in the observation schedule, the researcher observed that learners were quiet. T_5 seemed to be more interested in teaching L_1, but learners were more reserved. T_5 introduced the lesson nevertheless. These are the observations made in respect to L_1 in respect to the observation schedule tenets of NOIK.

- On **Empirical and metaphysical NOIK**, pedagogical practice that illuminate T_5 were clear, however he did not show or acknowledge the mother-nature in the introduction lesson and during the lesson. This includes the teacher's actions.
- On **the resilient and tentative NOIK**, pedagogical practice that illuminate T_5 were even clearer. The teacher did not engage learners' traditional experiences. The only routine done throughout the lesson was to involve western explanations using the textbook.
- On **inferential and intuitive NOIK**, T_5 was unsuccessful to observe the learners' traditional knowledge through eliciting it. No test and experiments were done.
- On **creative and mythical NOIK**, T_5 could not engage the learners in a way that would intrigue them to be creative. This means that the teacher also was unsuccessful to be creative in that sense. During the lesson, no myth was said to build up the knowledge.
- On **subjectivity of NOIK**, although T_5 was verbal he could not show subjectivity during the lesson. The subjectivity could have been shown how different scientists say about energy transfer in open and closed environment.
- On **social, collaborative, and cultural NOIK**, the teacher was a bit unsuccessful. From the time we entered the class and during the lesson, the learners were way distant and reserved. There were no social interactions, collaborations or engagement among learners about their culture.
- On **wisdom in action and functional application of NOIK**, there was little indication of what happens to our daily lives in relation to the topic.

On day 2, during L_2, there was not much difference done from L_1. The environment and teaching strategy were the same, where T_5 would be more vocal rather than engage learners.

Overall, for the inclusion of NOIK in the NS classroom, one has to understand the context in which learners are operating (Mavuru & Ramnarain, 2018). T_5 was operating in different contexts with his learners.

4.4.5.3 T_5 Post SSI

After the second lesson observation, the researcher like with previous teachers $T_{1, 2, 3 \& 4}$, interviewed T_5. The interviews were semi-structured where in they were asked in a non-sequential form. The SSI was conducted on T_5, then recorded. Below are the responses.

Question 1 responses

In your view, would you say the overall lesson was a success? Why?

T_5: Yes, I was satisfied with the way learners shared information among each other. Meaning teaching was successful and my objectives were easier to achieve.

The teacher's response in terms of satisfaction in relation to lessons were asked. This in turn gauged if he was aware that integration of IK took place. However, in this case, he responded in abstract terms. He gauged the lessons' success on learners' responses to the introduction of lesson made, which was wrong in the first place. When measuring the overall lesson's success, we checked learners' performance based on the assessment. The teacher hence was unsuccessful to draw conclusions of the lesson's success on right measurement.

Question 2 responses

Are you satisfied with the way you introduced your lesson? Why?

T_5: Yes, learners were able to come with example and cases of certain scenarios.

The teacher asked questions in terms of satisfaction of the lessons. This in turn gauged if the teacher aware that integration of IK took place. However, in this case, he responded in abstract terms. The teacher gauged the lesson's success on learners' responses to the introduction of the lesson made, which was wrong in the first place. When measuring the overall lesson success, we checked learners' performance based on the assessment. The teacher hence was a bit unsuccessful to draw conclusions of the lessons' success on right measurement.

Question 3 responses

Are you satisfied with your interaction with the learners? Why?

T_5: Absolutely satisfied, the class was full of information and idea sharing.

As a facilitator, the teacher was unsuccessful on the aspect of withitness of the classroom. If the teacher was observant and reflective enough, all the aspects of the classroom about interactions in lessons should have been considered, not only the aspect of learners' ability to collaborate in a question-and-answer session. The teacher was unsuccessful to unwind in detail all the aspects of the lessons he had, including assessment.

Question 4 responses

Would you say you used the relevant teaching method in this class? Why?

T_5: Yes, learners were highly interactive with their peers and teacher.

Again, the teacher became abstract in his reasoning. Despite the probing question why, the teacher's reasoning was not enough. Details should also include the factor of assessment as a major check of relevancy of a teaching method/s.

Question 5 responses

If there were some things you could change in your lesson, what would it be and why?

Change the way I planned my lessons. I would plan the whole lesson digitally.

T_5: I would only change the way I implemented the use of teaching aids; they were not enough.

The factor of learners' interruption simply shows that the lesson lacked somewhere. Across all discussions, my observation shows that the teacher was unsuccessful to include the factor of assessment as room for improvement. The teacher was unsuccessful in all reasoning to include assessment as a major factor.

Overall discussions

The interviews took place on the second day or after the second lesson, as the researcher administered SSI, the teacher was satisfied. During the administration of SSI, T_5 answers revealed different perspective. T_5 seemed most satisfied with the lessons he conducted. The reasons were that some of the learners raised hands, channelling T_5 to be convince that lesson was a success. However, I think the aspect of assessment as part of reasoning was left out.

4.4.6 Case 6 results and analysis

Below is T_6 data on the VNOIK questionnaire as administered prior to the lesson observations and post SSI.

4.4.6.1 T_6 VNOIK questionnaire results

Instructions

- From the questionnaire, the researcher anticipated the participants' responses in line with the VNOIK rubric above. Below is T_6's anticipated responses in contrast with the rubric. The table represents how T_6's responses were categorised and weighed.

Table 18: T6 categorised and weighed responses

Participant	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Q8**	**Q9**	**Q10**	**Overall score**
Teacher 6	PI	UI	PI	PI	PI	I	PI	PI	I	UI	
Weighing	1	0	1	1	1	2	1	1	2	0	1 (1.0)

- The table above shows that T_6 managed to score an overall average score of 1.0 out of a possible perfect overall average scores of 2. Moreover, the score shows that generally the participant has uninformed views about the nature of Indigenous Knowledge. The participant managed to reflect only informed

views on two questions out of a possible ten, which accounts for 20%, partially informed views on six questions out of a possible ten, which accounts for 60%, and uniformed views on two questions which accounts 20% of the scores. This makes T_6 partially informed about NOIK. Below is T_6's responses to support the overall average score provided above.

Table 19: T6 responses and analysis

Question	NS teachers' anticipated responses to questions
1	*"What Indigenous Knowledge is*: In relation to this question, T_6 managed to answer semi-appropriately by stating *"Indigenous Knowledge is a knowledge that is passed from generation to the other. This knowledge is seldom seen through aboriginal people, Africans, and red Indians".* The accuracy involves a partially informed view as Battiste (2002) defines Indigenous Knowledge as a knowledge that results from cultural philosophies which are area or societal based. The tenets of NOIK were not fully engaged on the response.
2	*"Role of experiments?* Regarding the question, the answer by T_6 *"They are taking it from their ancestors' knowledge. Indigenous Knowledge is passed from generation to generation"*. T_6 have showed partially informed view the answer was not clearly stating practitioners' involvement on the experiments.
3	*"Natural and unnatural causes?* T_6 on this question showed partially informed view as the response was "*Yes, supernatural causes, the nature of Indigenous Knowledge involves the knowledge about the day to day living of indigenous people and the reasons behind the occurrence of things in nature".* T_6 could separate Indigenous Knowledge from spirituality, beliefs, and metaphysics. The explanation did not suggest that the practitioners of Indigenous Knowledge follow

	certain guidelines.
4	*"Stays the same or changes over time?* On this question T_6 have shown partially informed view as the response was *"Yes, it stays the same, because their knowledge has to be passed through generations".* T_6 was not fully explaining the resilience and tentativeness of Indigenous Knowledge on the response.
5	*"How is knowledge generated? (Hoodia)* In determining how Indigenous Knowledge is generated, T_6 seemed to be partially informed. The response was "*They were taught by their forefathers".* The only aspect on the explanation is the aspect of repetition that assist in retention. Ancestors' knowledge passing was not involved.
6	*"Used to solve contemporary problems?* T_6 have shown Indigenous Knowledge as initial source of strategies to solve contemporary problems on the response *"Yes, people can go back to their old ways of doing things in order to rectify the sustainable development".* The teacher is eventually agreeing that Indigenous Knowledge can solve today's problems.
7	*"Methods and advice?* Methods: As for methods, T_6 clearly outline holistic approach which shows how physical systems are examined holistically through response *"Traditional medicine to rub the affected area".* Advice/treatment: The participant was unsuccessful to refer proper treatment from the holistic approach used by saying "*To get some of it and regularly apply*" meaning the approaches is the same.

	The two responses make the teacher to be portrayed as someone who hold partially informed view on the question.
8	*"Role of myths* T_6 on the role of myths score partially informed view as response *"Indigenous Knowledge is "Yes, for the sake of safety they do work"* clearly agreed to the myths involvement but did not state the importance of myths.
9	*"Reflect social and cultural values?* The teacher holds informed view on the question as he stated that "*Yes, different communities follow a particular trend that was used by their pre-decedents. For example, when they slaughter a cow, they would dry some of it (biltong) so to eat over time"* from the mostly knowledge systems, like Science, psychology and religion. Applied locally or universally? Acknowledgement that Indigenous Knowledge is transferred across communities, cultures and countries have been stated with examples.
10	*"Imagination, creativity* The teacher has shown uninformed view as his response "*NO, they cannot modify Indigenous Knowledge because it will not reflect their original roots"* shows Indigenous Knowledge is not a true base and a dynamic in continuing to apply creativity and innovation to sustain people's lives as example given did not show any creativity or imagination.

T_6 responses on Q_2 and Q_{10} are derived from the participant giving abstract explanations and lacked proper explanations with examples that are in-depth and detail. In most cases that are rated partially informed, T_6 could not state with examples in his response to support the statements given about Indigenous Knowledge. Hence, T_6 is rated partially informed about NOIK with weighing of 1.0 and percentage of 50% overall average score.

4.4.6.2 T_6 $L_{1\&2}$ observation schedule

Table 20:T6 L1&2 observation schedule

T_6 $L_{1\&2}$ observation schedule				
Learning area and topic	**kinetic energy (L_1) Potential energy (L_2)**			
Teaching method	**Lecture method ($L_{1\&2}$)**			
Number of learners	**57**			
Tenet of the NOIK	**Notes made from what is observed from the teacher**			
	Notes made from what is observed from the teacher (L_1)		**Notes made from what is observed from the teacher (L_2)**	
	Pedagogical practice that illuminates teachers' views (Notes)	***What actions/strategies/approaches would show us this view? (Notes)***	***Pedagogical practice that illuminates teachers' views (Notes)***	***What actions/strategies/approaches would show us this view? (Notes)***
Empirical and metaphysical NOIK *"Nature is real, partly, or generally tested and observed. Needs-based experimentation. The universe is orderly, metaphysical, and partly predictable"*. *(*Agrawal*, 1995; Bohensky & Maru, 2011; Le Grange, 2007, Ogunniyi, 2004; Cronje, De Beer & Ankiewicz, 2015, p. 323)*	The teacher did acknowledge that there are aspects in nature to do with kinetic energy.	The teacher spoke enough about motors in relation to kinetic energy.	The teacher did not acknowledge that there are aspects in nature to do with potential energy. He only explained the potential energy verbally. Learners listened without interaction; they did not get chance to add to what teacher have said.	The teacher in the lesson included the better method like demonstration.

Resilient yet tentative NOIK *"Indigenous Knowledge has withstood the test of time but is constantly changing as tradition; it is fluid and transformative linked to people's experiences. The elders' repository of ways of knowing is truth and not to be challenged" (Barnhardt, 2008; Bohensky & Maru, 2011; Senanayake, 2006; Cronje et al., 2015, p. 323).*	The teacher did not state that the knowledge of kinetic energy dated back in the days. Again, he could not show the resilient nor tentativeness of NOIK during his lesson.	The teacher should have acknowledged the past under kinetic energy.	The teacher did not state that the knowledge of potential energy dated back in the days. Again, he could not show the resilient nor tentativeness of NOIK during his lesson.	The teacher should have acknowledged the past under potential energy.
Inferential yet intuitive NOIK *"Facts are both tested and experimental observations made. Events have both natural and unnatural causes; metaphysical dimensions are important" (Le Grange, 2007; Ogunniyi, 2004; Senanayake, 2006).*	No experimentation was observed, nor tests done for observations.	The teacher was supposed to allow learners work on experiments and test so that they come up with their answers.	No experimentation was observed, nor tests done for observations.	The teacher was supposed to allow learners to work on experiments and test so that they come up with their answers.
Creative and mythical NOIK ***"****Observations and experimenting are not the only sources of ways of knowing. Human creativity,*	The teacher did not allow learners to work, but more talking or teaching was done by the teacher, including answering.	The teacher should have been creative with examples of experiments and tests that includes metaphors, imaginations, and myths. In addition,	The teacher did not allow learners to work, but more talking or teaching was done by the teacher, including answering questions.	The teacher should have been creative with examples of experiments and tests that includes metaphors,

imagination, metaphors and myths also play a role" (Barnhardt, 2008; De Beer & van Wyk, 2011).		the teacher should have allowed learners to be creative around the topic.		imaginations, and myths. In addition, the teacher should have allowed learners to be creative around the topic.
Subjectivity of NOIK *"Indigenous ways of knowing are based on cosmology and interwoven with culture and the spiritual. The elders can be influenced by prior ways of knowing and beliefs" (Aikenhead & Ogawa, 2007; Ogunniyi, 2004)*	The teacher did not acknowledge the past practice regarding the topic. None of the examples were even given to the learners.	IK was supposed to be cited from the ancient times with examples like the heat transfers in the mines.	The teacher did not acknowledge the past practice regarding the topic. None of the examples were even given to the learners.	IK was supposed to be cited from the ancient times with examples like the heat transfers in the mines.
Social, collaborative and cultural NOIK *"Indigenous Knowledge is situated in cultural tradition and within a certain historical–political context. It is the consequence of activities connected to everyday life in the natural environment of a group of people. It does not focus on the individual, but on the group and sharing.*	Daily interactions acknowledgements were made verbally, specifically on the skills learners practice every day like cooking. Multiple examples were not given though.	The teacher was supposed to state multiple examples on daily skills that learners practice and explain how heat transfer occurs in each example as stated.	Daily interactions acknowledgements were made verbally, specifically on the skills learners practice every day like cooking. Multiple examples were not given though.	The teacher was supposed to state multiple examples on daily skills that learners practice and explain how heat transfer occurs in each example as stated.

Indigenous Knowledge is locally rooted and ecologically based. It is generated at a specific place by people of that place. Indigenous Knowledge is orally transmitted Generalisations are relative within a certain context and can be shared among communities and beyond" (Agrawal, 1995, Barnhardt, 2008; Bohensky & Maru, 2011).				
Wisdom in action and NOIK *"Indigenous Knowledge is generated by practical engagement in everyday life through trial-and-error experiences. Repetition, imitation, and ceremonies are methods to aid retention and reinforce ideas. New ideas are rigorously tested in the 'laboratory of survival" (Senanayake, 2006, p. 87; Aikenhead & Ogawa, 2007; Barnhardt, 2008; De Beer & van Wyk, 2011).*	The teacher not that innovative, instead he kept on explaining many aspects of the lesson. The lesson was teacher-centred.	The teacher was supposed to be innovative and allow learners to experiment and do tests in anyway related to the topic.	The teacher not that innovative, instead he kept on explaining many aspects of the lesson. The lesson was teacher-centred.	The teacher was supposed to be innovative and allow learners to experiment and do tests in anyway related to the topic.

Functional application and NOIK *"Indigenous Knowledge is concerned with what and why things happen in nature, but also with what ought to happen. Emphasis is on functional application and skills. Indigenous Knowledge is concerned with the everyday lives of people rather than facts, theories, and laws" (Agrawal, 1995, Aikenhead & Ogawa, 2007).*	The examples did not give learners applications and skills as they were not stated enough.	The teacher was supposed to give more examples related to the topic that apply to the everyday life context.	The examples did not give learners applications and skills as they were not stated enough.	The teacher was supposed to give more examples related to the topic that apply to the everyday life context.
Holistic approach of Indigenous Knowledge *"Indigenous Knowledge is 'a conglomeration of knowledge systems' (Ogunniyi, 2007a, p. 965) including Science, religion, psychology, and other fields. Problems are solved in a holistic manner addressing all the smaller parts with no boundaries with the metaphysical world" (Agrawal, 1995; Senanayake, 2006).*	The teacher did not trigger learners' curiosity, otherwise they would have come up with many examples related to the topic and others would be ancient.	The teacher ought to trigger learners' curiosity, so that they come up with many examples related to the topic.	The teacher did not trigger learners' curiosity, otherwise they would have come up with many examples related to the topic and others would be ancient.	The teacher ought to trigger learners' curiosity, so that they come up with many examples related to the topic.

Observation schedule discussions

Before filling in the observation schedule, the researcher observed that learners were quiet. T_6 seemed to be more interested in teaching L_1, but learners were more reserved. T_6 introduced the lesson nevertheless. These are the observations made in respect to L_1 in respect to the observation schedule tenets of NOIK.

- On **Empirical and metaphysical NOIK**, pedagogical practices that illuminate T_1 were clear. However, he did not show or acknowledge the mother-nature in the introduction lesson and during the lesson. This includes the teacher's actions.
- On **the resilient and tentative NOIK**, pedagogical practices that illuminate T_6 were clear. The teacher did not engage learners' traditional experiences. The only routine done throughout the lesson was to involve western explanations using the textbook.
- On **inferential and intuitive NOIK**, T_6 was unsuccessful to observe the learners' traditional knowledge by eliciting it. No tests and experiments were done.
- On **creative and mythical NOIK**, T_6 could not engage the learners in a way that would intrigue them to be creative. This means that the teacher was also uncreative in that sense. During the lesson, no myth was said to build up the knowledge.
- On the **subjectivity of NOIK**, although T_6 was verbal, he could not show subjectivity during the lesson. The subjectivity could have been shown how different scientists say about energy transfer in open and closed environment.
- On **social, collaborative, and cultural NOIK**, the teacher was a bit unsuccessful. From the time we entered the class and during the lesson, the learners were way distant and reserved. There were no social interactions, collaborations or engagement among learners about their culture. .
- On **wisdom in action and functional application of NOIK**, there was less indication of what happens to our daily lives in relation to the topic.

On day 2, during L_2, there was not much difference done from L_1. The environment and teaching strategy were the same, where T_6 would be more vocal rather than engage learners.

Overall, to ensure the inclusion of NOIK in the NS classroom, one has to understand the context in which learners are operating (Mavuru & Ramnarain, 2018). T_6 was operating in different contexts with his learners.

4.4.6.3 T_6 Post SSI

After the second lesson observation, the researcher, like with previous teachers $T_{1, 2, 3, 4 \& 5}$, interviewed T_6. The interviews were semi-structured, wherein they were asked in a non-sequential form. The SSI was conducted on T_6, then recorded. Below are the responses.

Question 1 responses

In your view, would you say the overall lesson was a success? Why?

T_6: Yes, because I managed to achieve the lesson objectives, which was learners should be able to know the definition of kinetic energy and be able to give examples across.

The teacher asked questions in terms of satisfaction of the lessons. This in turn gauged if he was aware that integration of IK took place. However, in this case, he responded in abstract terms. He gauged the lesson's success on learners' responses to the introduction, which was wrong in the first place. When measuring the overall lesson's success, we checked learners' performance based on the assessment. The teacher hence was unsuccessful to draw conclusions of the lessons' success on the right measurement.

Question 2 responses

Are you satisfied with the way you introduced your lesson? Why?

T_6: Yes, all learners captured the term kinetic energy definition and were able to relate the kinetic energy to their everyday life.

The teacher asked questions in terms of satisfaction of the lessons. This in turn gauged if he was aware that integration of IK took place. However, in this case, he responded in abstract terms. He gauged the lesson's success on learners' responses to the introduction, which was wrong in the first place. When measuring the overall lesson's success, we checked learners' performance based on the assessment. The teacher hence was unsuccessful to draw conclusions of the lesson's success on the right measurement.

Question 3 responses

Are you satisfied with your interaction with the learners? Why?

T_6: No, I did not give them a chance to interact.

As a facilitator, the teacher was a bit unsuccessful in the aspect of withitness of the classroom. If the teacher was observant and reflective enough, all the aspects of the classroom lessons' interaction should have been considered, not only the aspect of learners' ability to collaborate in a question-and-answer session. The teacher was unsuccessful to unwind in detail all the aspects of the lessons he had, including assessment.

Question 4 responses

Would you say you used the relevant teaching method in this class? Why?

T_6: No, because the method was not learner-centred as required in the policy CAPS.

Again, the teacher became abstract in his reasoning. Despite the probing question why, the teacher's reasoning was not enough. Details should also include the factor of assessment as a major check of relevance of teaching method/s.

Question 5 responses

If there were some things you could change about your lesson, what would it be and why?

T_6: I would change my planning when it comes to teaching method and aids.

The factor of learners' interruption simply shows that the lesson lacked somewhere. Across all discussions, my observation shows that the teacher could not include the factor of assessment as room for improvement. The teacher was somehow unsuccessful in all reasoning to include assessment as a major factor.

Overall discussions

The interviews took place on the second day or after the second lesson. As the researcher administered SSI, the teacher was satisfied. During the administration of SSI, T_6's answers revealed different perspectives. T_6 seemed most satisfied with the lessons he conducted. The reasons were that some of the learners raised hands, channelling T_6 to be convinced that the lesson was a success. However, I think the aspect of assessment as part of reasoning was left out.

4.5 Conclusion

Chapter 4 has presented and discussed the data collected through the VNOIK questionnaire, observation schedule and SSI. The chapter was presented and analysed towards answering the research questions. Each instrument was presented, and each participant's response was analysed using related themes as per the tenets of NOIK. This was done to establish if the NS hold either informed, partially or uninformed views on NOIK. Furthermore, to establish the influence of views on involved teachers' pedagogical practices.

Chapter 5 Summary, Conclusions, and Recommendations

5.1 Introduction

This chapter gives summary, conclusions and recommendations of the data presented and discussed in the previous chapter (Chapter 4). The summary, conclusions and recommendations are based on the title of this study; exploring grade 7 Natural Sciences teachers' views about the nature of Indigenous Knowledge and how their views influence their classroom practice. This chapter also attempted to answer both research questions underpinning the study using either the observation schedule, SSI or VNOIK questionnaire as the data collection instruments of the study. Below are the research instruments attempting to answer the research questions of the study, and are followed by the conclusions and recommendations.

5.2 Overview of the instruments and the study framework (IST)

Below is the summary of the tenets of IST (physical, human and sacred world) combined with the tenets of NOIK for T1-T6 as included in the VNOIK questionnaire and observation schedule.

Table 21: IST tenets matched with NOIK tenets

IST tenet	**the tenets of NOIK**
Physical world	*What Indigenous Knowledge is* *Used to solve contemporary problems?* *Methods and advice?*
Human world	*What Indigenous Knowledge is* *Role of experiments?* *How is knowledge generated?* *Reflect social and cultural values?* *Imagination, creativity*

sacred world	*What Indigenous Knowledge is* *Natural and unnatural causes* *Role of myths*

Physical world

Rigney (1999) argues that the physical world is a tenet that talks more about the land, which shapes an individual, in this case NS teacher. An individual in this case can be shaped by own cultural background and practice. In this study, NS teachers who have shown to have been more influenced by the physical world through the VNOIK questionnaire is T_4. The teacher also extended the observation schedule. T_4 shared and engaged her learners positively with her knowledge. This showed that the physical world had more influence on her actions. She was then followed by other participants (T_1, T_2, T_3, T_5 and T_6). These participants showed moderate influence, especially on the VNOIK questionnaire.

The Human world

Foley (2003) elaborated that the human world tenet has the potential to influence beings due to approaches to people, family, rules of behaviour, ceremonies of people and their ability to change. T4 again has shown a great deal of influence by the human world on the VNOIK. She showed that she has interacted a lot with the above relics. When being observed, it was just a confirmation of what she portrayed on the VNOIK. She was creative, showing that she is using the influence of myths and imagination. By looking at her responses from the VNOIK questionnaire, this indicated that she has a sound knowledge of IK. Other participants (T_1, T_2, T_3, T_5 and T_6) showed a moderate influence, especially on the VNOIK questionnaire rather than on observation schedule.

Sacred world

When it comes to the sacred world, Foley (2003) states that spiritual beliefs (metaphysics) play a pivotal part in one's approach. The statement integrates one's influence by the other two tenets. The same teacher who has shown to excel in the

above tenets also seem to include the aspects of the sacred world tenet in her practice. Others have shown moderate influence.

5.3 Discussions and analysis of findings from data presentation

The discussions and analysis of findings below emanate from the three instruments (observation schedule, semi-structured interviews and VNOIK questionnaire), which was done in the period of twelve days, with two days allocated per case. Each case was observed twice, and on the second observation day, a semi-structured interview was done followed by the filling in of the VNOIK questionnaire by participants.

5.3.1 Observation Schedule

5.3.1.1 Discussions and analysis of observation schedule in all six cases

As a passive observer, the researcher had no influence in all cases of observation, either in day one or two of the case. The participants were aware of the researcher's presence, and they already knew about their anonymity for comfortability. The observation was done to address research question number two, which attempted to unravel how NS teachers' views about the NOIK influence their classroom practice. This could be shown by the adequateness in integrating IK. Thus, the themes below were established to tackle the question.

5.3.1.2 Trend on observation across six cases on both lessons

From the literature, Zidny *et al.* (2020) state that the inclusion of NOIK by a teacher in the classroom is a requirement. This is done by the teacher who is knowledgeable about NOIK, meaning he/she includes aspects or tenets of NOIK in their practice (Taylor & Cameron, 2016; Magni, 2017).

On Tenet 1, *Empirical and metaphysical NOIK*

On the aspect of the empirical and metaphysical NOIK, the researcher observed two trends. T_1 and T_5 did not include the above-mentioned aspect. In their two lessons, they did not include examples and aspects of nature, and that nature exists. Their lessons did not elicit curiosity to learners as they were given less chance to come up

with examples. However, T_2, T_3, T_4 and T_6 included the aspect of nature with some examples.

On Tenet 2, *Resilient yet tentative NOIK*

On this aspect, only T_3 and T_4 went further to give more examples in their lessons about nature. To further acknowledge nature, they elicited learners' curiosity to come up with more examples and emphasised that the examples also existed in the past years and were used by native ancestors. However, other teachers (T_1, T_2, T_5 and T_6) were unable to include adequate examples in their lessons.

On Tenet 3, *Inferential yet intuitive NOIK*

T_2, T_4 and T_5 took learners through more magnifying lenses by engaging them in experimentation. The experimentations were either done through demonstrations or given to learners to do the experiment themselves. In this way, the experimentation allowed proper integration of knowledge being learnt with examples. The rest of the teachers (T_1, T_3 and T_6) were unable to engage learners in experimentation of any sort and did not demonstrate any experimentations themselves in their lessons.

On Tenet 4, *Creative and mythical NOIK*

In creative and mythical NOIK, only T_2 and T_4 demonstrated it well. Even though they were not outstanding, they were found to be satisfactory. This means that the two teachers were creative enough to create lessons that included examples with exciting experiments and tests that include metaphors, imaginations and myths. In addition, the teachers allowed learners to be creative around the topics concerned. The rest of teachers (T1, T3, T5 and T6) did not accurately demonstrate the aspect, and they were found to be inadequate.

On Tenet 5, *Subjectivity of NOIK*

The subjectivity comes as all humans may influence science through their disciplinary and theoretical commitments. This influence includes, among others,

one's beliefs, culture, spirituality, prior ways of knowing and cosmology (Cronje *et al.,* 2015; Reddy, 2018). Only T_4 showed subjectivity, and the rest of the teachers did not demonstrate subjectivity on their lessons as they showed to have influence on their lessons.

On Tenet 6, *Social, collaborative, and cultural NOIK*

Although some teachers did not do any experimentations with proper examples in their lessons, the rest of the teachers showed to have mastered the aspect of social, collaborative and cultural NOIK. Their ratings ranged from satisfactory to adequate. This was properly demonstrated by $T_{2,}$ who excelled in all the tenets. In both lessons, T_2 made adequate practical examples that learners encounter in their everyday life. Furthermore, T_2 allowed learners to collaborate effectively in both lessons. Science is forever influenced by social and cultural practice (DBE, 2012; Cronje *et al.,* 2015). T_2 showed to have adequately understood the aspect of social and cultural practice. Other teachers tried to give social examples and cultural practice in their lessons. However, they left out the aspect of collaboration among learners when implementing their lessons. Hence, they were rated on a satisfactory level.

On Tenet 7, *Wisdom in action and NOIK*

From all the 6 NS teachers, only T_4 and T_5 were rated on a satisfactory level on wisdom in action. Both teachers in all the lessons dwelt much on being innovative. The innovation through observation was showed through experimentation. Some experiments were not fully conducted due to limited resources. T_4 and T_5 used video display as a way of being innovative, even though their overall lessons were teacher-centred. Other teachers appeared to be not innovative enough across the boundaries. Hence, they were found to be inadequate when it comes to wisdom in action.

On Tenet 8, *Functional application and NOIK*

Only T_2 and T_4 were rated on a satisfactory level for their lessons. The two teachers gave learners knowledge that enabled them to come up with examples that concern

their everyday life. Thus, applications and skills were grasped in this manner. Other teachers gave moderate lessons when it comes to demonstrating applications and skills to the learners. In addition, there was no evidence to show that other teachers integrated IK with evidence of application and skills (De Beer, 2016).

On Tenet 9, *Holistic approach of Indigenous Knowledge*

None of the teachers was proficient enough in terms of a holistic approach. In this tenet, problems are solved in a holistic manner by addressing all smaller parts with boundaries in relation to the metaphysical world (Cronje *et al.,* 2015). None of the teachers addressed their lessons with boundaries when it comes to the metaphysical world. Hence, they were found to be inadequate.

5.3.1.3 Observation Schedule Summary and coding from T1-T6

In an attempt to answer research question number 2: how do Natural Sciences teachers' views on NOIK influence their classroom practice, although the researcher was using an observation schedule as a passive observer, he had no influence on the outcomes. The main aspect that was being observed was the integration of IK on the lessons delivered in the NS classroom. The observer recorded the notes in the lesson observation schedule for each teacher in every lesson. The notes were taken during the lesson from its start to the end.

All the teachers did not adequately integrate IK in their practice except T_4. Below is a table that summarises how NS teachers integrated IK in their practice. This shows the impact of NS teachers' views on NOIK in their practice. Their 'correctness' was measured against the VNOIK framework as in chapter 2 in 2.12.1 as adopted in Cronje, De Beer and Ankiewiczs (2015). On each tenet in the framework, the researcher measured either question as Inadequate (IA), satisfactory (S) or adequate (A).

Table 22: observation schedule overall coding

Tenet from VNOIK framework as in observation schedule	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**T_6**

Empirical and metaphysical in nature	IA	S	A	S	IA	A
Resilient yet tentative	IA	IA	S	A	IA	IA
Inferential yet intuitive	IA	S	IA	A	A	IA
Creative and mythical	IA	S	IA	S	IA	IA
subjective	IA	IA	IA	A	IA	IA
Social, collaborative and cultural perspectives	S	A	S	S	S	S
Wisdom in action	IA	IA	IA	S	S	IA
Functionally applied Science	IA	S	IA	A	IA	IA
Holistic approach	IA	IA	IA	IA	IA	IA
PERCENTAGE	IA=65%		S=26%		A=9%	

The table above shows that NS teachers were not integrating IK in their practice. The main reason could be that they were all not prepared enough to do this. This has also been reported by Dekkers (2006), Kurup (2014) and Linneman *et al.* (2003). As much as they were not fully prepared, there could be other reasons for their unpreparedness. In chapter 2, the exclusion of NOIK in the classroom by Life Sciences and Physical Sciences teachers was due to their reluctance to integrate IK. This study has proven that NS teachers were not fully prepared when it comes to integrating IK in their practice. The unpreparedness was observed as majority of the teachers did not answer the questions on the VNOIK framework in 2.12.1 in chapter 2 as adopted from Cronje, De Beer and Ankiewiczs (2015).

The assumption emanating from the unpreparedness by NS teachers to integrate IK is matched with the same reasons why Life Sciences and Physical Sciences teachers are reluctant or unprepared to integrate IK in their classrooms. Among other reasons, NS teachers may still be trapped in colonial teaching practice, and this underestimates the significance of integrating IK in the classroom (Shizha, 2008; Verbuyst, 2022).

In answering research question number 2: how do Natural Sciences teachers' views on NOIK influence their classroom practice, the study found the question

inconclusive as the teachers were more reluctant to integrate IK, where they mostly scored IA (inadequate scores) in their respective observation schedule.

5.3.2 Semi-Structured Interviews

5.3.2.1 Discussion and analysis of the findings on SSI instrument

Post SSI was administered in six cases. Post SSI was employed to further investigate teachers' personal knowledge of NOIK. The researcher deliberately administered SSI to unpack the lessons that were delivered by NS teachers. This was done to assess if they were aware of what they taught. The researcher found that majority of NS teachers understood what they were teaching, including the integration of IK. This is so because most teachers were mostly satisfied with the lessons they implemented.

5.3.2.2 Trend across SSI questions

Below is the summary of the NS teachers' satisfactory ranks.

Table 23: SSI overall coding

Teacher	Satisfied	Not satisfied
T_1	✓	
T_2	✓	
T_3	✓	
T_4		✓
T_5	✓	
T_6	✓	

The above table shows that most participants were satisfied with the lessons they had, despite the researcher disagreeing that they did not integrate IK. This means that they were not aware whether or not the integration of IK took place in their practice.

5.3.3 VNOIK questionnaire

5.3.3.1 Trends across VNOIK questionnaire questions

On the second day of teachers' observation, each NS teacher was given a questionnaire to complete. The questionnaire strove to address the question: what are grade 7 NS teachers' views on NOIK? The questionnaire assisted the researcher to establish if either the teacher held an Informed (I), partially Informed (PI) or an uniformed view. Below is the analysis question by question which was transcribed by the participants (T_1-T_6) which will lead to a summary or conclusion. Participants' responses were grouped based on their similarity, and a summary was drawn and presented in the following way.

What Indigenous Knowledge?

On this question, T_1 and T_4 were found to have an informed view on the question, as their responses were mostly similar. Their responses were *"Indigenous Knowledge is people's knowledge and skills that are possessed in a particular locality which makes the people to benefit from their own environment"* and *"Indigenous Knowledge according to my understanding, is the knowledge, skills acquired by virtue of societal beliefs, is it rooted on historical experiences, and is transmitted by the elderly in the society to the young ones. It is not universal since it is more based on diverse ideologies. For example, where a person lives or one's culture".* The accuracy involves an informed view as Battiste (2002) and Moulaison and Bossaller (2017) defined Indigenous Knowledge as knowledge that results from cultural philosophies which are societal based. The other teachers (T_2, T_5 and T_6) did show integration of cultural philosophies in their definitions with the exception of mentioning that IK is societal based. All this excludes T_3, as the teacher gave less details when responding to questions.

Role of experiments?

On this question, T_1, T_3 and T_4 were found to be informed. One of the responses from the three participants was: *"Indigenous Knowledge is referred to as "wisdom in action" Indigenous Knowledge engages the accumulation of knowledge through*

practical experiences of local people using trial and error method". The response demonstrated an informed view as it explained the role of experiments by practitioners through the trial and error method. This shows that acts generated by Indigenous Knowledge are derived from experimental observations and tests (Cronje *et al.,* 2015). The other participants (T_2, T_5 and T_6) held an unformed view as they could not provide sufficient responses to the question.

Natural and unnatural causes?

Only T_1 held an uninformed view on this question, as his response was "*The nature of Indigenous Knowledge embraces the "functional application". It involves the knowledge about the day to day living of indigenous people and the reasons behind the occurrence of things in nature".* T_1 could not separate Indigenous Knowledge from spirituality, beliefs and metaphysics. The explanation suggests that the practitioners of Indigenous Knowledge follow certain guidelines. T_3, T_4 and T_5 held an informed view as they separated Indigenous Knowledge from spirituality, beliefs and metaphysics. However, T_2 and T_6 held a partially informed view because they could separate Indigenous Knowledge from spirituality, beliefs and metaphysics, and their explanation did not suggest that the practitioners of Indigenous Knowledge follow certain guidelines.

Stays the same or changes over time?

On this question, T_1, T_2, and T_4 held an informed view while T_3, T_5 and T_6 held a partially informed view. T_1, T_2, and T_4 explained the resilience and tentativeness of Indigenous Knowledge in depth. However, T_3, T_5 and T_6 denied the tentative part of NOIK. T_1, T_2, and T_4 stipulated that IK existed for a long period of time and pulled through many generations but new discoveries in the near future may lead to some changes in IK, due to changes in traditions that display flexibility and transformability (Reddy, 2018). This explanation is in line with the resilience and tentativeness of NOIK. However, T_3, T_5 and T_6 disagree with this statement.

How is knowledge generated?

T_1, T_2, T_4 and T_6 were found to be partially informed in their responses. The only aspect in their explanation was that of repetition that assists in retention, but the passing of knowledge from generation to generation was not mentioned. For

example, T_1 responded by saying: "*I think they gathered facts about the plant through observation and testing. Practical experiments are also involved where Phenomena which are natural and unnatural are observed and tested by indigenous people through experiments and conclusions are drawn from them".* T_1, T_2, T_4 and T_6 lacked involvement or acknowledgement of ancestral knowledge passing to the next generations. T_3 and T_5 were uniformed about the question. Zinyeka *et al.* (2016) and Taylor and Cameron (2016) believe that scientific knowledge can be generated through trial-and-error methods, which ancestors used and passed over to the next generation. T_3 and T_5 did not mention anything regarding the passing of IK to the next generation.

Used to solve contemporary problems?

Only T_5 was uniformed in his response. This was because the question required strong emphasis that IK can solve today's problems in various ways with the inclusion of examples. T_5 did not fully agree that IK can solve today's problems unlike T_1, T_3 and T_4, who fully believed that IK could eradicate contemporary problems by saying: *"…Integration of IK assists on the relevancy of Science curriculum, the link between Science and Indigenous Knowledge and the sustainable development of the education system".* Moreover, arguments by DBE (2012) and Šūmane *et al*. (2018) put emphasis on the belief that IK can eradicate majority of problems in today's dynamic world. Only T_2 and T_6 could not come up with proper examples to substantiate why their responses indicate that IK can eradicate problems in today's world.

Methods and advice?

T_2 and T_3 excelled in the question as they were rated to be informed. In addition, T_1, T_4, T_5 and T_6 were rated on a partially informed level. Regarding the methods, T_2 and T_3 clearly outlined a holistic approach which shows how physical systems are examined holistically through their similar responses like *"The traditional healer will at least give the athlete something to apply on the affected area; like herbs that can be rubbed against the spot".* They also recommended that they *"…apply usually before going to the match or competitions*" meaning the approach is the same. The two responses make the teacher to be portrayed as someone who holds an informed

view on the question. T_1, T_4, T_5 and T_6 could not give proper or appropriate advice or treatment.

Role of myths

T_1 to T_4, were found to be informed. This was because most of their responses included Indigenous Knowledge as being "mythical and creative". Their responses included that of T_1 who stated that "…*Indigenous people have a nature of creative reasoning. There are some myths that are detected among the elderly and indigenous people and the role that they play is unique in their way of life. For example, the Tsonga community in South Africa creatively practice a myth that discourages young girls to engage in sexual activities at a tender age. It is said that having sex at a young age will result in the girls loosing parts of their hair for good".* This clearly shows the importance of myths. However, T_5 was found to be uninformed, whilst T_6 was partially informed. On the role of myths, T_6 scored a partially informed view based on the response *"Indigenous Knowledge is "Yes, for the sake of safety they do work"* clearly agreed to the myths involvement but did not state the importance of myths. As for T_5, he clearly shattered the use of myths across Indigenous Knowledge, hence he was found to be uniformed on this question.

Reflect social and cultural values?

T_1, T_2, T_3 and T_6 were found to have an informed view on this question. They all agreed with examples that Indigenous Knowledge is transferred across communities, cultures and countries. T_5 held an uniformed view because his response was that "*I don't believe that Indigenous Knowledge can be used and reflects the social and cultural values …"* T_5 could not state with examples in his response that Indigenous Knowledge is transferred across communities, cultures and countries. T_4 held a partially informed view due to lack of appropriate examples.

Imagination, creativity

Participants T_1, T_3, and T_4 included imagination and creativity in their explanations, hence, they were found to be informed on this question. Examples of responses

are from T_1 who stipulated that "…*This knowledge engages imitating, repeating and cultural activities which allows indigenous people to keep and make emphasis on ideas. Indigenous Knowledge is not the final stage of knowledge discovery but a way towards gaining wisdom…"* This shows that Indigenous Knowledge is a true base and a dynamic in continuing to apply creativity and innovation to sustain people's lives. T_2, T_5, and T_6 were found to be uninformed on the question as they showed that Indigenous Knowledge is not a true base and a dynamic in continuing to apply creativity and innovation to sustain people's lives with no proper examples given.

5.3.3.2 VNOIK questionnaire Summary from T_1-T_6

ST stipulates that every learner and teacher come to the classroom with their own traditional knowledge (Zidny *et al.,* 2020). In terms of NS teachers, the knowledge they hold about NOIK before or after the class determines if the teacher holds either I, PI or UIviews on NOIK. VNOIK was used to establish the level of knowledge or views they have about NOIK. All the selected NS teachers filled in the questionnaire fairly with no obstruction.

It was important for the NS teacher's knowledge on NOIK to be assessed. This is so because NS teachers should be knowledgeable about NOIK (Hewson *et al*., 2009). The measurements were made against the VNOIK rubric adopted from Cronje, De Beer and Ankiewiczs (2015). Coding was then done per question, and the teacher scored either I, PI or UI. Each teacher coded based on the 10 questions from the VNOIK questionnaire against the VNOIK rubric. Thereafter weighting was calculated, the total weighing was 2.0. So, a value from 0 to 0.67 was regarded as UI, from 0, 68 to 1.34, it was regarded as PI and from 1, 35 to 2.0 as I.

The findings are shown below in the two tables, one showing coding and the other showing the percentages.

The table was used to code NS teachers' responses on the VNOIK questionnaire. Code I (informed), PI (partially informed) and UI (uninformed) were used. Their rating were I=2, PI=1 and UI=0. Similarly, the overall score was rated as per scores 0 (Uninformed), 1 (partially informed) and 2 (Informed).

Table 24: VNOIK questionnaire overall coding

Participant	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Overall score
Teacher 1	I	I	UI	I	PI	I	PI	I	I	I	
Weighing	2	2	0	2	1	2	1	2	2	2	1 (1.6)
Teacher 2	PI	UI	PI	I	PI	PI	I	I	PI	UI	
Weighing	1	0	1	2	1	1	2	2	1	0	1 (1.1)
Teacher 3	UI	I	I	PI	UI	I	I	I	I	I	
Weighing	0	2	2	1	0	2	2	2	2	2	2 (1.5)
Teacher 4	I	I	I	I	PI	I	PI	I	I	I	
Weighing	2	2	2	2	1	2	1	2	2	2	2 (1.8)
Teacher 5	PI	UI	I	PI	UI	UI	PI	UI	UI	UI	
Weighing	1	0	2	1	0	0	1	0	0	0	1 (0.5)
Teacher 6	PI	UI	PI	PI	PI	I	PI	PI	I	UI	
Weighing	1	0	1	1	1	2	1	1	2	0	1 (1.0)

The table below shows the VNOIK average percentages as results from the questionnaire.

Table 25: VNOIK questionnaire overall coding percentage

Teacher	Uniformed	Partially informed	Informed
1	10%	20%	70%
2	20%	50%	30%
3	20%	10%	70%
4	0%	20%	80%
5	60%	30%	10%
6	20%	60%	30%
Total % skewedness	110	210	290

In an attempt to answer research question number 1 of the study: what are NS teachers' views on NOIK, Table 25 above shows that the high percentage is on informed views. As such, the skewedness goes towards the informed views section. The above findings clearly suggest that NS teachers hold informed views on NOIK.

5.4 Conclusion

Upon data representation, discussions, analysis and summary, the researcher attempted to answer the two research questions. The first research question was: “what are NS teachers’ views on NOIK”? This question was mostly answered using the VNOIK questionnaire and SSI. This study has shown that NS teachers hold informed views on NOIK. The conclusion was drawn from the VNOIK questionnaire and SSI instruments used. The results also showed that NS teachers who obtained their diplomas and degrees from institutions of higher learning appear to be knowledgeable in NOIK. This is so because NS teachers who have ACE certificates were found to be uninformed. Furthermore, teaching experience did not appear to have an influence on the results. In addition, NS teachers hold larger percentage that is skewed towards informed views on NOIK.

In answering the second research question, an observation schedule and SSI were used. Through direct interpretation and thematic content analysis on observation schedule, participants were supposed to be observed based on the VNOIK framework. However, majority were not fully prepared to include integration of IK in their practice. The failure was assumed to be due to the unpreparedness by NS teachers to integrate IK in their practice. Hence, the second question was: “how do NS teachers’ views on NOIK influence the classroom practice”? This question was found to be inconclusive. This is so because the participants did not fully include or integrate IK in their practice.

The overall conclusion was that NS teachers held informed views on NOIK, and they were more comfortable in writing about NOIK on the VNOIK questionnaire. However, they did not integrate IK in their practice, and this hindered the determination of the influence of their views on NOIK in their practice. These results are in accordance with those by Chuene (2018), who focused on Science teachers’ views about NOS and its influence in their classroom practice.

5.5 Recommendations

The study was well conducted upon the observation of all protocols that guided it. Although there are many NS teachers out there with different IK backgrounds, this

study has treated six cases in Dimamo Circuit in Capricorn South District. As such, the researcher suggests that in the future, the sample should come from at least two or more circuits. Furthermore, the choice of grades should be relaxed to give the researcher an advantage to access and synthesise more information from the literature.

When conducting this research, the researcher considered observing the participants twice to enable him to validate the data from one lesson to the other. One observation was enough, as the participants tend to repeat the same aspects from the previous lesson. So, it would be better if future researchers could observe the repetition or duplication of data as it demands ample time from the researcher. The semi-structured interviews follow-up questions should be ready so that they can be included in the study. In addition, the researchers should ask uniform questions to all the participants. The data has shown that NS teachers who hold diplomas and bachelors' degrees are as knowledgeable as teachers with more teaching experiences. Therefore, future researchers should not be too quick to draw their conclusions based on teachers' experiences and qualifications.

The researcher of this study was more specifically focused on knowing what views NS teachers hold about NOIK, and how those views influence their classroom practice. Although NS teachers hold informed views on NOIK, they are unable to integrate IK. This made their views on NOIK to be unclear in their classroom practice. One of the assumptions was that NS teachers are not fully prepared to integrate IK in their classroom even though they are informed. This may motivate upcoming researchers to investigate why NS teachers cannot integrate IK in their classroom practice. This in turn, will show how their views influence their classroom practice.

Deviating from the section about future researchers, short learning programmes should be implemented for NS teachers. This will help them to improve their classroom pedagogical practice, which in these cases have shown that the teachers concerned are not reflective. Hence, short learning programmes need to be considered.

5.6 Limitations of the study

The study focused on grade 7 NS teachers' views on NOIK in Dimamo Circuit in Capricorn South District. This meant that grades 8 and 9 NS teachers were not included in the study, and other teachers in other circuits or regions were not included as well. This made the researcher to make the conclusions based on one grade in one circuit instead of several grades from different circuits.

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Appendices of the study

APPENDIX A: Letter to the Limpopo Department of Basic Education

DEPARTMENT OF MATHEMATICS SCIENCE AND TECHNOLOGY EDUCATION

Private Bag X1106, Sovenga, 0727, South Africa

Cell: 06764047683, Email: malatjipholuso@gmail.com

1996 Sickline, Mankweng

SOVENGA

0727

03 APRIL 2022

The head of department

Limpopo Department of Basic Education

Corner 113 Biccard & 24 Excelsior Street

POLOKWANE

0700

Dear sir/Madam

Request for permission to conduct research

I hereby like to request for permission to conduct an academic research at a school operating in Dimamo Circuit. Currently I am a registered Master of Science Education student at the University of Limpopo. As part of the requirements for the fulfilment of the degree, I am required to conduct research and produce a dissertation.

The title of my research is: **EXPLORING GRADE 7 NATURAL SCIENCES TEACHERS' VIEWS ABOUT NATURE OF INDIGENOUS KNOWLEDGE AND HOW THEIR VIEWS INFLUENCE THEIR CLASSROOM PRACTICE**

The aim of the study is:

- To explore grade 7 Natural Sciences teachers' views about the Nature of Indigenous Knowledge (NOIK).
- To determine how those views influence their practice.

The study will involve grade 7 teachers. The researcher will observe six teachers, interview and give them a questionnaire in response to what the researcher has observed and their knowledge of NOIK. The researcher will keep a journal to record the responses and actions of the participants. Participation is voluntary and if any one wishes to withdraw at any time, he/she will be allowed to do so. I am going to adhere to all the ethical procedures. Lastly, participants' identity and research site will be protected. Thus, pseudonyms will be used in the research study.

All queries regarding the research project may be directed to Mr P Malatji at 071 729 8805 or malatjipholuso@gmail.com

Supervisor: Dr. Maluleke T at tinyikomaluleke@ul.ac.za

Co-supervisor: Mr. K.J Chuene at 015 268 3888 or karabo.chuene@ul.ac.za

Yours in Education

Malatji P (Mr)

APPENDIX B: Letter to the Circuit

DEPARTMENT OF MATHEMATICS SCIENCE AND TECHNOLOGY EDUCATION

Private Bag X1106, Sovenga, 0727, South Africa

Cell: 06764047683, Email: malatjipholuso@gmail.com

1996 Sickline, Mankweng

SOVENGA

0727

03 APRIL 2022

Dimamo Circuit Manager

PO BOX 638

POLOKWANE

0700

Dear sir/Madam

Request for permission to conduct research

1. The matter above bears reference.
2. I am a Science Education Master's student at the University of Limpopo. As part of the requirements for the fulfilment of the degree, I need to conduct a research and produce a thesis.
3. This letter serves to request for permission to conduct research at **five primary schools in Dimamo** Circuit of **Capricorn South Education District**.
4. The topic of the proposed study is **"Exploring grade 7 Natural Sciences teachers' views about nature of Indigenous Knowledge and how their views influence their classroom practice"**. The envisaged participant will be one grade 7 NS teacher in each school. The research process will not affect the day-to-day academic activities of the school. All the relevant research ethics will be adhered to.
5. I will be glad if the department can grant me the permission to conduct the study.

Yours in Education

Malatji P (Mr)

APPENDIX C: Letter to the school principals

DEPARTMENT OF MATHEMATICS SCIENCE AND TECHNOLOGY EDUCATION

Private Bag X1106, Sovenga, 0727, South Africa

Cell: 06764047683, Email: malatjipholuso@gmail.com

1196 Sickline, Mankweng

SOVENGA

0727

03 APRIL 2022

The School Principal

Sebayeng Primary School

Stand no 704

SOLOMONDALE

0964

Dear sir/Madam

Request for permission to conduct research in your school

1. The matter above bears reference.
2. I am a Science Education Master's student at the University of Limpopo under the supervision of Dr Maluleke and MR KJ Chuene. As part of the requirements for the fulfilment of the degree, I need to conduct a study and produce a thesis.
3. This letter serves to request for permission to conduct the study at **your school**.
4. The topic of the proposed research is **"Exploring grade 7 Natural Sciences teachers' views about nature of Indigenous Knowledge and how their views influence their classroom practice"**. The envisaged participants of the study are grade 7 NS teachers. My research process will not affect the day-to-day academic activities of the school because all relevant research ethics will be adhered to.
5. The confidentiality of the information gathered will be maintained. Anonymity of the learners of the school will be maintained throughout the whole process. I trust that my request will be favourably considered

Yours in Education

Malatji P (Mr.)

APPENDIX D: Informed Consent Forms

Consent form 1

Dear participant

My name is Pholuso Malatji, I am student (No: 201502017) at the University of Limpopo and I am currently studying towards master's in Science Education. As a part of my study, I am required to carry out a study titled: **Exploring grade 7 natural sciencses teachers' views on nature of Indigenous Knowledge and how those views influence their practice.** The purpose of the study is to explore how grade 7 Natural Sciences teachers view the Nature of Indigenous Knowledge and how those views influence their practice.

These observations and interviews or questionnaires are designed to explore:

- How Natural Sciences teachers view the Nature of Indigenous Knowledge and how those views influence their practice?

I would appreciate it if you would allow me to spend time with you for both the classroom observations and interviews or questionnaires. Please bear in mind that this is an academic endeavour. Anonymity will be compulsory, and the data collected will be used only for research purposes. All responses are confidential and will be treated as such.

As a participant, if you agree to take part in the study, you will then be observed in your class for one lesson and be interviewed or provided with questionnaire after the being observed.

ARE THERE ANY CONDITIONS THAT MAY EXCLUDE YOU FROM PARTICIPATING IN THE STUDY?

- You must be a Natural Science teacher and currently teaching Natural Sciences as a subject in Senior phase in Dimamo Circuit.
- You must be a teacher who include Indigenous Knowledge in the classroom.

WHAT WILL YOU BE REQUIRED OF YOU IN THE STUDY?

Should you decide to partake in the study, you should expect the following:

- To sign the consent form.
- To be observed for one lesson by the researcher delivering through integration of Indigenous Knowledge.
- To be interviewed or questioned by the researcher after the lesson observation.

WHAT ARE THE POSSIBLE BENEFITS THAT MAY ARISE FROM THE STUDY?

The benefits of participating in the study are as follows:

- This study will help improve your understanding of Indigenous Knowledge and its integration.
- This study will help you in identifying your weaknesses and strengths when teaching Science.

WILL YOU RECEIVE ANY FINANCIAL COMPENSATION OR PAYMENTS FOR PARTICIPATING IN THE STUDY?

Please be informed and note that you will not receive any form of payment for taking part in the study.

WHAT ARE YOUR RIGHTS AS A PARTICIPANT IN THE STUDY?

You have the right to withdraw from the study at any given time as your participation is voluntary. Should you wish to withdraw, you will not be penalised or be disadvantaged in the future. You do not have to provide a reason for your decision to withdraw from the study. You may also be excused from participation if you do not comply with the researcher's requirements as this may temper with the authenticity of the outcomes of the study.

HOW WILL YOUR CONFIDENTIALITY AND ANONYMITY BE ENSURED IN THE STUDY?

Confidentiality of the data will be kept, and your identity will only be known to the researcher. Your identity will not be revealed during or after the study even if it is published.

DO I HAVE A CHOICE OF PARTICIPATION?

Everyone in the study has a right to participate in the study, and a choice to withdraw.

Consent Form 2

I _____ agree to participate in the research study named (**EXPLORING GRADE 7 NATURAL SCIENCSES TEACHERS' VIEWS ON NATURE OF INDIGENOUS KNOWLEDGE AND HOW THOSE VIEWS INFLUENCE THEIR PRACTICE).**

The temperament and rationale of the study has been explained to me in writing and I am therefore participating voluntarily.

I give permission for my observation, discussion and interview with Malatji Pholuso to be tape recorded.

I understand that no financial compensation will be made for participating in the study.

I understand that I can withdraw from the above stated research study, without any penalties, at any time, either before it commences or while I am participating.

I understand and accept all my rights as a participant.

I understand that anonymity will be ensured in the write-up by disguising my identity.

Signed: _____ Date: _____

APPENDIX E: Invitation Letter to the concerned Teacher

DEPARTMENT OF MATHEMATICS SCIENCE AND TECHNOLOGY EDUCATION

Private Bag X1106, Sovenga, 0727, South Africa

Cell: 06764047683, Email: malatjipholuso@gmail.com

1196 Sickline, Mankweng

SOVENGA

0727

03 APRIL 2022

Sebayeng Primary School

Stand no 704

SOLOMONDALE

0964

Dear sir/Madam

Invitation to be a participant in my study

1. The matter above bears reference.
2. I am a Science Education Master's student at the University of Limpopo under the supervision of Dr Maluleke and MR KJ Chuene. As part of the requirements for the fulfilment of the degree, I am request for your permission to include you as a participant in the study.
3. This letter serves to request for your approval to conduct research with you being a participant; grade 7 Natural Sciences Teacher.
4. The topic of the proposed research is **"Exploring grade 7 Natural Sciences teachers' views about nature of Indigenous Knowledge and how their views influence their classroom practice"**. The envisaged participants of this study are grade 7 NS teachers. The research process will not affect the day-to-day academic activities of the school because all relevant research ethics will be adhered to.
5. The confidentiality of the information gathered will be maintained. Anonymity of the learners of the school will be maintained throughout the whole process. I trust that the request will be favourably considered

Yours in Education

Malatji P (Mr.)

APPENDIX F: Semi-structured interviews (SSI)

Guidelines:

- *There is no 'wrong, and 'right' answer to the questions asked, your opinion is the key for the researcher regarding Indigenous Knowledge.*
- *When answering, elaboration and giving examples based on your answer is required to some of the questions.*

Questions;

1. In your view, would you say the overall lesson was a success? Why?
2. Are you satisfied with the way you introduced your lesson? Why?
3. Are you satisfied with your interaction with the learners? Why?
4. Would you say you used the relevant teaching method in this class? Why?
5. If there were some things you could change about your lesson, what would it be and why?

APPENDIX G: Views on the Nature of Indigenous Knowledge (VNOIK)

Personal details

a. Name: _____

b. Date: / /

c. Date of birth: .....
d. Sex: M / F
e. Name of school: .....
f. Highest qualification: .....
g. Teaching experience in years: ……
h. All subjects taught in the past 3 years: .....
i. All grades taught in the past 3 years: .....

Instructions

- Please answer each of the following questions. You can use all the space provided and back pages to answer a question.
- Some questions have more than one part. Please make sure you write answers for each part.
- This is not a test and will not be graded. There are no “right” or “wrong” answers to the following questions. I am only interested in your ideas relating to the following questions.

Questions:

1. In your view, what is indigenous (or traditional) knowledge?

   What makes Indigenous Knowledge different from other types of knowledge systems (such as Western knowledge)?

2. Practitioners of indigenous Science (e.g. elders, herbalists, traditional healers) observe nature to generate knowledge. Do they do experiments

and tests in order to verify or validate this knowledge?

- If yes, explain how they test or validate their knowledge.

- If no, explain why not.

3. Practitioners of Indigenous Knowledge observe nature and give explanations about their observation. Elders in a community can, for example, explain where lightning comes from. Do the elders always use natural causes to explain their observations such as lightning, or do they sometimes include supernatural causes in their explanations?

   - If they only use natural causes, explain why and give examples of some of the causes.

   - If they sometimes use supernatural causes, explain why and give examples of some of the causes.

4. Indigenous Knowledge is transferred from one generation to the next over many decades and centuries.

   Does this knowledge stay the same or does it change over time?

   - If yes, explain why it stays the same.

- If no, explain the causes of such changes.

5. *Hoodia gordinii* is a plant that was used by Khoi-San hunters to suppress their hunger and thirst when they went on hunting expeditions. How **do you think** the Khoi-San people came to know that this particular plant has these properties?

6. Sustainable development is an emerging concept that includes topics such as hunger, poverty and underdevelopment. Globally, governments and organisations struggle to find solutions for these important issues. **Do you think** Indigenous Knowledge can be used to alleviate some of these problems?

   - If you say yes, please explain why and how Indigenous Knowledge can be used to solve these problems.

   - If you say no, please explain why it cannot be used to solve these problems.

7. An athlete regularly competing in marathons struggles with pain in his legs during the last part of a marathon and can sometimes not complete a marathon due to this. The athlete decides to consult a traditional healer to determine why his legs pain during the last part of a marathon.

   - What methods **do you think** the traditional healer will apply to diagnose the problem when consulting with the athlete?

   - What possible treatment or advice **do you think** he will give the athlete?

8. Myths are stories that are told in different cultures by elders from one generation to the other. Do you think myths and rituals play any important

role in Indigenous Knowledge systems? Explain your answer with examples where possible.

9. Some claim that Indigenous Knowledge is infused with social and cultural values. That is, it reflects the social and political values, philosophical assumptions and intellectual norms of the specific culture in which it is practised. Indigenous Knowledge is thus generated locally and can only be used in a specific area. It cannot be used universally in other contexts or globally to solve different problems.
   - Do you believe that Indigenous Knowledge reflects the social and cultural values of a specific community? Explain with the use of examples how Indigenous Knowledge reflects the social and cultural values of a local community

   - Do you believe that Indigenous Knowledge can only be used in a specific area or do you believe it can be used in other areas or globally to solve problems? Explain your answers with examples.

10. Indigenous Knowledge is passed from one generation to the other by elders. The elders are deemed very important and some people believe their ways of knowing (knowledge) is truth and cannot be challenged. Does this mean that current practitioners of Indigenous Knowledge must use this knowledge exactly as it was passed on to them, or can they use their creativity and imagination to modify the Indigenous Knowledge to solve current problems?

   - If you say yes and believe that Indigenous Knowledge practitioners cannot change this knowledge, explain why. Use examples where possible.

   - If you believe that Indigenous Knowledge practitioners can change

and modify their knowledge, explain why. Use examples where possible.

APPENDIX H: Observation schedule

Teacher's name		
Grade		
Learning area and topic		
Teaching method		
Tenet of the NOIK	**Notes made from what is observed from the teacher**	
	Pedagogical practice that illuminate teachers' views (Notes)	***What actions/strategies/approaches would show us this view?(Notes)***
Empirical and metaphysical NOIK *"Nature is real, partly or generally tested and observed. Needs-based experimentation. The universe is orderly, metaphysical and partly predictable" .(Agrawal, 1995; Bohensky & Maru, 2011; Le Grange, 2007, Ogunniyi, 2004; Cronje, De Beer & Ankiewicz, 2015, p. 323)*		
Resilient yet tentative NOIK *"Indigenous Knowledge has withstood the test of time, but is constantly changing as tradition; it is fluid and transformative—linked to people's experiences. The elders' repository of ways of knowing is truth and not to be challenged" (Barnhardt, 2008; Bohensky & Maru, 2011; Senanayake, 2006; Cronje et al., 2015, p. 323).*		
Inferential yet intuitive NOIK		

"Facts are both tested and experimental observations made. Events *have both natural and unnatural causes; metaphysical dimensions are* *important" (Le Grange, 2007; Ogunniyi, 2004; Senanayake, 2006).*		
Creative and mythical NOIK ***"****Observations and experimenting are not the only sources of ways of knowing. Human creativity, imagination, metaphors and myths also play a role" (Barnhardt, 2008; De Beer & van Wyk, 2011).*		
Subjectivity of NOIK *"Indigenous ways of knowing are based on cosmology and interwoven with culture and the spiritual. The elders can be influenced by prior ways of knowing and beliefs" (Aikenhead & Ogawa, 2007; Ogunniyi, 2004)*		
Social, collaborative and cultural NOIK *"Indigenous Knowledge is situated in cultural tradition and within a certain historical–political context. It is the consequence of activities connected to everyday life in the natural environment of a group of people. It does not focus on the individual, but on the group and sharing. Indigenous Knowledge is locally rooted and ecologically based. It is generated at a specific place by people of that place. Indigenous Knowledge is orally transmitted Generalisations are relative* *within a certain context and can be shared among communities and beyond" (Agrawal, 1995, Barnhardt, 2008; Bohensky & Maru, 2011).*		
Wisdom in action and NOIK *"Indigenous Knowledge is generated by practical engaugement in everyday life through trial and error*		

experiences. Repetition, imitation and ceremonies are methods to aid retention and reinforce ideas. New ideas are rigorously tested in the 'laboratory of survival" (Senanayake, *2006, p. 87; Aikenhead & Ogawa, 2007; Barnhardt, 2008; De Beer &* *van Wyk, 2011).*		
Functional application and NOIK *"Indigenous Knowledge is concerned with what and why things happen* *in nature, but also with what ought to happen. Emphasis is on functional application and skills. Indigenous Knowledge is concerned with the everyday lives of people rather than facts, theories and laws" (Agrawal, 1995, Aikenhead & Ogawa, 2007).*		
Holistic approach of Indigenous Knowledge *"Indigenous Knowledge is 'a conglomeration of knowledge systems' (Ogunniyi, 2007a, p. 965) including Science, religion, psychology and other fields. Problems are solved in a holisticmanner addressing all the* *smaller parts with no boundaries with the metaphysical world" (Agrawal,* *1995; Senanayake, 2006).*		

APPENDIX I: Ethics clearance certificate

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TURFLOOP RESEARCH ETHICS COMMITTEE

ETHICS CLEARANCE CERTIFICATE

MEETING: **23 May 2022**

PROJECT NUMBER: **TREC/94/2022: PG**

PROJECT:

Title:	Exploring Grade 7 Natural Sciences Teachers' Views About Nature Of Indigenous Knowledge And How Their Views Influence Their Classroom Practice.
Researcher:	P Malatji
Supervisor:	Dr TG Maluleke
Co-Supervisor/s:	Mr KJ Chuene
School:	School of Education
Degree:	Master of Education (Science Education)

PROF D MAPOSA
CHAIRPERSON: TURFLOOP RESEARCH ETHICS COMMITTEE

The Turfloop Research Ethics Committee (TREC) is registered with the National Health Research Ethics Council, Registration Number: **REC-0310111-031**

Note:

i) **This Ethics Clearance Certificate will be valid for one (1) year, as from the abovementioned date. Application for annual renewal (or annual review) need to be received by TREC one month before lapse of this period.**

ii) **Should any departure be contemplated from the research procedure as approved, the researcher(s) must re-submit the protocol to the committee, together with the Application for Amendment form.**

iii) **PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES.**

APPENDIX J: Permission to use the instrument (VNOIK)

Gmail KARABO CHUENE <chuenekj@gmail.com>

Permission for your student to use the VNOIK Instrument

2 messages

Josef De Beer <jdebeer@uwc.ac.za> Fri, Jul 28, 2023 at 3:17 PM
To: KARABO CHUENE <chuenekj@gmail.com>

Dear Mr Chuene

Thank you for your call.

Dr Annelize Cronje developed the VNOIK instrument as part of his PhD study, and I was her supervisor. She sadly passed on a few years ago. I was the second author of the article in which the VNOIK instrument was published, and I hereby provide permission to your student for using the VNOIK instrument. I actually welcome it, as his insights will further strengthen the work on indigenous knowledge border-crossing in the classroom.

Kind regards

Josef

Prof Josef de Beer
Director: Science Learning Centre for Africa
Tel (o) (021) 959-2649
Faculty of Education

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KARABO CHUENE <chuenekj@gmail.com> Fri, Jul 28, 2023 at 3:46 PM
To: Josef De Beer <jdebeer@uwc.ac.za>

Thank you very much Prof, much appreciated.
[Quoted text hidden]

APPENDIX J: Permission to use the instrument (VNOIK)

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24 September 2023

Dear Sir/Madam

SUBJECT: EDITING OF DISSERTATION

This is to certify that the masters dissertation entitled 'Exploring Grade 7 Natural Sciences teachers' views about nature of indigenous knowledge and how their views influence their classroom practice' by Malatji Pholuso has been edited and proofread, and that unless further tampered with, I am content with the quality of the dissertation in terms of its adherence to editorial principles of consistency, cohesion, clarity of thought and precision.

Kind regards

Prof SJ Kubayi (DLitt et Phil)