Exploring an intervention on how to integrate local or indigenous knowledge on the features of the moon in Grade 4 classes

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By

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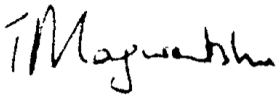
Declaration of Originality

I, Thando Magwentshu declare that this thesis is my own original work. It is being submitted for the Masters' Degree at Rhodes University and has not been submitted before for any degree in any other University. All ideas and citations used in this study derived from other people are acknowledged and indicated in the list of references.



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Abstract

The National Curriculum Statement (R-12) calls on all Natural Sciences teachers to integrate local or indigenous knowledge (IK) into their lessons. However, this seems to be easier said than done. For instance, in my experience as a Natural Sciences teacher I have observed that the Department of Education does not adequately equip and support teachers with the necessary pedagogical skills to integrate IK in science lessons. It is against this background that this study sought to explore an intervention on the development and implementation of model lessons on features of the moon that integrate local or IK in Grade 4 classes.

The study adopted a qualitative case study approach underpinned by an interpretivist perspective. Within the interpretive paradigm, a qualitative case study approach was employed. The participants were four Grade 4 Natural Sciences and Technology teachers from selected schools in the Chris Hani West District. Data were gathered and triangulated using questionnaires, semi-structured interviews, document analysis, a presentation by an expert community member, workshop discussions and journal reflections. Vygotsky's socio-cultural theory and Shulman's pedagogical content knowledge (PCK) were used as a theoretical framework and analytical framework respectively. From the socio-cultural theory, three concepts were used: *social interactions*, *mediation of learning* and the *zone of proximal development* (ZPD). Additionally, within PCK, Mavhunga and Rollnick's (2013) five Topic Specific Pedagogical Content Knowledge components: *learners' prior knowledge, what is difficult to understand, curricular saliency, representations* and *conceptual teaching strategies* were used as analytical tools. A thematic approach to qualitative data analysis was adopted, to come up with sub-themes in relation to my research questions.

The findings from this study revealed that before the intervention, some teachers had a narrow understanding of local or IK and how it could be integrated in their lessons. As a result, some teachers had never implemented integration of local or IK as required by the Curriculum and Assessment Policy Statement (CAPS) and the principles of the National Curriculum Statement. The findings of this study thus showed that after the intervention, teachers felt equipped with understanding of local or IK. Additionally, they were able to develop their own model lessons that

integrated it. The study thus recommends that teachers should be supported as far as possible in order to be able to integrate local or IK in their science lessons.

Key Concepts: Natural Sciences and Technology, features of the moon, local or Indigenous Knowledge, Professional Development, Socio-cultural Theory, Topic Specific Pedagogical Content Knowledge

Dedication

This thesis is dedicated to my late father, Jacob Xhobiso Magwentshu and my late mother Alice Thenjiwe Magwentshu who raised me up, teaching me principles of life, to be a strong man and motivating me to study in the field of education. Finally, I further dedicate this thesis to my lovely wife Mavis '*Nolutho*' Magwentshu, *uMaShandu* (her clan name) for being a responsible, caring, and loving wife and encouraging me to study.

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My praying wife, Mavis, who has been my great source of strength. I owe my lovely wife and my children Sino, Ali, Ngcali, Bala and Zoda hundreds of hours of family time that I could not afford them during my Master's journey. They prayed, provided emotional support and ensured that I always had internet connectivity at home.

Many thanks too to my great family for prayers. Sinathemba, Kamva and Komani *ukwanda kwaliwa nguMthakathi.*

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List of Abbreviations and/or Acronyms

BEd: Bachelor of Education

CK: Content Knowledge

CoP: Community of Practice

CMC: Circuit Management Centre

CPD: Continuing Professional Development

IK: Indigenous Knowledge

IKSs: Indigenous Knowledge Systems

LK: Local Knowledge

LCE: Learners' Centred Education

LTSMs: Learning Teaching Support Materials

MKO: More Knowledgeable Other

OBE: Outcomes Based Education

PCK: Pedagogical Content Knowledge

PK: Pedagogical Knowledge

PLC: Professional Learning Community

WS: Westernised science

SMK: Subject Matter Knowledge

TSPCK: Topic Specific Pedagogical Content Knowledge

ZPD: Zone of Proximal Development

CHAPTER ONE: SITUATING THE STUDY

1.1 Introduction

The main goal of my study was to explore an intervention on how to integrate local or indigenous knowledge on the features of the moon in Grade 4 classes in the Chris Hani West District. In this chapter, the context is described. A summary of the research goal, objectives and questions follow and the conceptual and theoretical frameworks of the study are highlighted. The data gathering techniques are described, followed by the definition of key concepts used, the significance of my study and the thesis outline. The chapter ends with a chapter summary.

1.2 Context of the Study

According to McMillan and Schumacher (2010), the context of the study plays a significant role in helping the reader to understand the importance and the contribution of the study to the worldview. Hence, in this section I discuss the calls to integrate indigenous or local knowledge into the curriculum, in the South African context, as well as the organisation of the Natural Sciences and Technology curriculum. I conclude by describing my school experience, so that the reader is able to understand my choices of the research framework and methods, and why I interpreted data the way I did.

1.2.1 Calls to integrate indigenous knowledge into science lessons

Over recent decades, calls to broaden science curricula have been made in many countries around the world. The aim is to accommodate alternative sources of knowledge known as, among other titles, traditional knowledge, aboriginal knowledge, indigenous knowledge, traditional environmental knowledge, ethnoscience, and indigenous science in science curriculum (Hodson, 2009). In the context of this study, the terms local knowledge and indigenous knowledge are used interchangeably.

These calls have influenced the activities, instructional practices, and curricula in schools in a number of countries such as Hawaii (Chin, 2007), Tonga (Palefau, 2005), Canada (Aikenhead, 2006), New Zealand (Ministry of Education, 1993; Roberts, 1998), and Namibia (NCBE, 2010) to mention just a few. Scholars such as Mukwambo, Ngcoza and Chikunda (2014) note that there is a need for Africanisation of the school science curriculum. These scholars argue, that this has to do with introducing methods and approaches in teaching and learning that can be adapted and made relevant to the African context.

Scholars such as Erinosho (2013), Le Grange (2007), Nyika (2017) and Shizha (2007) also support the integration of indigenous knowledge (IK) in teaching of science, believing that IK benefits learners in learning science. For instance, it may increase the participation of learners (Sedlacek & Sedova, 2017), contextualises science (Aikenhead & Jegede, 1999) and enhances parental involvement (Klein 2011; Lareau, 1987). Sedlacek and Sedova (2017) suggest that the participation of learners in the lesson determines the quality of the teaching and learning process. Furthermore, Aikenhead and Jegede (1999), state that IK encourages learners to engage with the materials that are familiar to them as they are exposed to scientific concepts. Admittedly, when learners see the connection between everyday activities and what is learned in the classroom, participation in classroom activities can be enhanced. This might also give an opportunity for the learners to interact socially as proposed by Vygotsky (1978), so that they can share their experiences. This suggests that the inclusion of IK in science lessons might serve as the starting point in teaching science concepts (Simasiku, Ngcoza, & Mandikonza, 2017).

Some studies have shown that students coming from non-Western backgrounds usually struggle to learn science meaningfully, and they sometimes have to suppress their own ways of thinking in order to be consistent with science (Aikenhead & Elliott, 2010; Cameron, 2010). Expanding on the seminal work of Vygotsky (1978), Roschelle (1995), Maselwa and Ngcoza (2003), as well as Mavuru and Ramanarain (2017), assert that there is a need for teaching methods whose starting point is what learners already know from home. That is, it should be recognised that learners are required to use their socio-cultural background knowledge when constructing their science knowledge. In light of this, the valuing of Indigenous Knowledge Systems (IKS) is one of the principles of the South African curriculum.

1.2.2 The South African context

For the past two decades, the South African curriculum documents for Natural Sciences and Life Sciences have been calling for integration of traditional and indigenous knowledge in the curriculum. For instance, the policy document of the Revised National Curriculum Statement (RNCS) (South Africa. Department of Education [DoE], 2002), the National Curriculum Statement (NCS) (South Africa. DoE, 2003), and the Curriculum and Assessment Policy Statement (CAPS) (South Africa. DoE, 2011) for Natural Sciences (NS), recognise and affirm the critical role of Indigenous Knowledge Systems (IKS) in science education. Reasons given in the above curriculum statements for the call to integrate science with IKS, are that such systems reflect the wisdom and values that people living in southern Africa have acquired over centuries and much of this valuable wisdom is believed to have been lost in the last 300 years of colonisation (Ogunniyi, 2007; South Africa. DoE, 2011).

Also, the Department of Education considers the integration of IKS and science as an opportunity to focus on the affective dimension of science education. Lastly, the integration of indigenous knowledge is intended to demonstrate the interrelationship between science, technology, indigenous knowledge systems, the environment and society (South Africa. DoE, 2011). Hence, the Natural Sciences Specific Aim 3, relates to understanding the applications of Natural Sciences in everyday life, as well as understanding the history of scientific discoveries and the relationship between indigenous knowledge and science (South Africa. DoE, 2011). Essentially, the aim is to expose learners to different worldviews, allowing them to appreciate, compare and evaluate different scientific perspectives (Kuphe, 2014).

Currently, however, there are hardly any noticeable practical steps taken by the Department of Education regarding IK-science integration. Instead, the implementation process has been left up to the teachers (Moyo, 2011). Moreover, the Natural Sciences and Technology CAPS document makes no mention of IK, beyond the underpinning principles in the introduction (South Africa. DoE, 2011). Throughout all my years as a Natural Sciences teacher and currently as a Subject Advisor, I have noted that most teaching and learning materials include none or very few topics that integrate local or IK. Furthermore, I have observed that the Department of Education does not

adequately equip and support teachers with the necessary pedagogical skills to integrate IK in Natural Sciences lessons. That is, the DoE does not provide IK exemplars in terms of model lessons that can be used by Natural Sciences teachers. For instance, the four to five-day workshops that subject advisors conduct, are not enough to develop teachers' subject matter knowledge (SMK) and pedagogical content knowledge (PCK) as espoused by Shulman (1987).

As a result of the absence of guidelines for the integration of IK, most teachers do not feel obliged to implement IK in sciences (Naidoo, 2007; Mushayikwa & Ogunniyi, 2011). This dire need for teacher development on both SMK and PCK has also been prompted by the fact that in a recent content gap and teaching methodology workshop on Sasol *Inzalo* for Grade 6 Natural Sciences and Technology teachers, not a single teacher made mention of local or IK when they demonstrated how they teach certain Natural Sciences lessons. In hindsight, this contradicts Specific Aim 3, which suggests that learners should learn science within the context of their societal or cultural knowledge (South Africa. DoE, 2011; Mavuru & Ramnarain, 2017). This interventionist study is therefore developmental in nature, as it aims at enabling Natural Sciences and Technology teachers within a community of practice (CoP) (Wenger, 1998) to integrate IK when teaching science. In the context of this study, CoP refers to a group of people who share a concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis (Wenger, 1998; Wenger, McDermott & Synder, 2002).

As a newly appointed Subject Advisor, my aim is to focus on continuing professional development (CPD) (Eun, 2008; Ngcoza & Southwood, 2015). Essentially, in the context of my study, CPD refers to any activities aimed at enhancing knowledge and skills of teachers by means of orientation, training and support (Coetzer, 2001). In my view, effective CPD should firstly be aware of and address the specific needs of teachers (Bredeson, 2003; Muijs, Day, Harris, & Lindsay, 2004). This study took the form of a CPD, albeit on a small scale, and it aimed at addressing the integration of local or IK in science lessons. SMK has to do with the actual subject matter within a specific subject (Shulman, 1986), of which in the context of this study the focus was on Natural Sciences and Technology. On the other hand, PCK involves multiple aspects such as teachers being able to elicit learners' prior knowledge, curricular saliency, knowing what makes a topic easy or difficult to understand, representations including analogies, as well as conceptual

teaching strategies (Geddis & Wood, 1997; Mavhunga & Rollnick, 2013). These five topic specific pedagogical content knowledge (TSPCK) components are not discrete but are instead interwoven. The topic of focus of my study was the features of the moon.

1.2.3 Organisation of the Natural Sciences and Technology content

The content in the Natural Sciences and Technology (NSTECH) syllabus is organised around four 'knowledge strands' shown in Table 1.1 below (South Africa. DBE, 2011a).

Table 1.1: Showing Natural Sciences and Technology knowledge strands

Natural Sciences	Technology
Life and living	Structures
Matter and Materials	Processing
Energy and Change	System and control
Planet Earth and Beyond	

It is expected in the NSTECH curriculum that the topics within each strand, as well as the knowledge strands themselves, are not treated as separate or independent of each other. Table 1.2 details the concepts and content progression.

Table 1.2: Progression map of NSTECH content knowledge

GRADE 4							
STRANDS		**STRANDS**		**STRANDS**		**STRANDS**	
Life and Living	Structures	Matter and Materials	Structures	Energy and change	Systems and control	Planet Earth and Beyond	Systems and control
Living and non-living things Structure of plants and animals What plants	Structures for animal shelters	Materials around us Solid materials	Strengthening materials Strong frame structures	Energy and Energy transfer Energy around us Energy and sound	Movement energy in a system	Planet Earth The Sun The Earth & the Sun The moon	Rocket systems

need to grow Habitats of animals							

As mentioned earlier, the topic of focus in this study was the features of the moon in Grade 4 classes. This is one of the fundamental topics in the knowledge strand the 'Planet Earth and Beyond'. Research shows that learners have misconceptions about the moon (Benacchio, 2001). These misconceptions include:

- The moon phases are due to the earth's shadow;
- Eclipses of the moon are the same as the phases of the moon; and
- Moon is emitting light, exactly as the sun does.

This knowledge strand requires teachers to have a deep knowledge of Geography. The majority of Natural Sciences teachers, especially in Chris Hani West District, have not studied Geography as their major subject, and most of them have indicated having problems in mastering this knowledge strand. This poses challenges, especially in teaching the topic on the features of the moon. Several problems are also encountered on the learners' side. Benacchio (2001) attributes some of these problems to the fact that most children in developed countries are living in light polluted areas, which makes the night sky not clearly visible. This is the same situation, that some of the children who live around the Chris Hani district, face.

1.2.4 My school experience

My school experience was very different from my home experience. At home, my grandmother would wake us up based on the crowing of the rooster or based on the chirping of the first birds. At home, my grandparents used the sun, the moon and the stars to mark time. For instance, they would look at how the sun was positioned in the sky to tell if it was midday or the afternoon. When I was growing up, elders used to make generally accurate predictions of the weather. They knew from wind directions when it was likely to rain and with what intensity, and when drizzle

conditions were likely to be experienced. They could tell when there was going to be dew or frost. They could tell from very distant lightning flashes, the likelihood of their areas receiving rainfall. The repeated passing of such comments on the weather and other natural phenomena helped to put us, as children, in the picture, and as we grew up we were also able to make relatively accurate weather predictions. Much of the knowledge I had acquired at home was not required at school and maybe was regarded as irrelevant. At school I started memorising concepts without even understanding their meaning. To me school was about writing an essay about a journey by train, whereas I had never seen or stepped onto a train.

In standard 6, I remember learning about the elements of a periodic table. We were required to memorise the first 20 elements, of which one of those elements was sulphur. It is only now that I am the Subject Advisor that I learnt that sulphur is known as *isibabula.* I then realised that I had known about sulphur since I was a toddler, but I had known it by a different name. My grandmother would buy *isibabula* from the nearby shop and use it as a means to deworm children, Had my teacher used isiXhosa language or had he drawn from our socio-cultural experiences to mediate our learning as reiterated by Mavuru and Ramnarain (2017), I would have known what we were learning about. Perhaps, I would have understood more of those lessons and I would probably have been more interested, and perhaps I would have remembered more. Another term that I only found out about when I was doing my Bachelor of Education at Rhodes University, is fungi. I was taught the five life kingdoms and I learnt to memorise them using mnemonics, only to learn that fungi is *ingubo zamasele, ukungunda, amakhowa.*

I regret, not only my school years, when this knowledge was not used as a foundation on which to build new knowledge as proposed by Roschelle (1995), but my years of high school teaching and teacher education, when I did not assist my own learners to, according to Aikenhead and Jegede (1999), do border crossing from their homes to school science. It is from this background, that I sought to discover how local or indigenous knowledge (IK) could be integrated in school science. Making science attractive and accessible to students is a major focus of science education (George, 2013). The integration of local or indigenous knowledge (IK) in science teaching and learning contributes to this goal, through being attentive to relevance and sensitivity to students' cultural contexts (Webb, 2013).

1.3 Statement of the Problem

The new curriculum calls on all Natural Sciences teachers to integrate local or indigenous knowledge (IK) into Natural Sciences lessons. In my experience as a Natural Sciences teacher, however, I have observed that the Department of Education does not adequately equip and support teachers with the necessary knowledge and pedagogical skills to integrate local or indigenous knowledge (IK) in their science lessons. Furthermore, the majority of textbooks provide few examples on integration of IK into Natural Sciences lessons. This study therefore sought to explore an intervention, focusing on the co-development of model lessons that integrated IK in Grade 4 Natural Sciences and Technology lessons on the features of the moon.

1.4 Rationale for the Study

There have already been a number of studies on the integration of IK into Science teaching in Namibia and South Africa under the Rhodes University's umbrella research programme. My study forms part of this research umbrella. Its main purpose was to support teachers on how to integrate IK in Natural Sciences lessons. This was achieved through the presentation by the expert community member, as well as the co-development of model lessons that integrated IK in the topic of the features of the moon in particular. Additionally, this study aimed at creating an enabling environment for Natural Sciences and Technology teachers to develop their own model lessons that integrate IK.

1.5 Significance of the Study

It is hoped that this study might provide an opportunity for development of model lessons that integrate IK in the topic the features of the moon. It is envisaged that such model lessons might improve both SMK and PCK of Grade 4 Natural Sciences and Technology teachers of Komani CMC. This study might also advance my educational practices as a new Subject Advisor and enable me to assist teachers with improving their teaching pedagogies, based on integration of IK in science classrooms in particular, more so when I prepare to conduct future continuing professional development workshops for teachers (Ngcoza & Southwood, 2015).

Lastly, through collaborating with expert community members who are knowledgeable about IK and local practices (Klein, 2011), this study might afford the opportunity to document this knowledge and make it available for use in local schools, which could help to build bridges between everyday knowledge from home or community and at school. Aikenhead and Jegede (1999) refer to this as border crossing.

1.6 Research Goal, Objectives and Questions

This section outlines the research goal, the research objectives and research questions of my study.

1.6.1 Research goal

The main goal of my study was to explore an intervention on development and implementation of model lessons on the features of the moon that integrate IK in Grade 4 classes. To achieve this goal the following objectives and research questions guided this study:

1.6.2 Objectives

1. To find out Grade 4 Natural Sciences and Technology teachers' experiences, perspectives and pedagogical insights on the integration of local or indigenous knowledge in science lessons.
2. To determine lessons that grade 4 Natural Sciences and Technology teachers can learn (or not) through co-analysing curriculum documents.
3. To explore the learning opportunities that are created (or not) during the presentations by an expert community member on indigenous practices in relation to the moon, sun and stars.
4. To plan and co-develop model lessons on the features of the moon that integrate local or indigenous knowledge.

1.6.3 Research questions

This study was thus guided by the following research questions:

1. What are Grade 4 Natural Sciences and Technology teachers' experiences, perspectives and pedagogical insights on integration of local or indigenous knowledge in science lessons?

2. What lessons can Grade 4 Natural Sciences and Technology teachers learn (or not) through co-analysing curriculum documents?

3. What learning opportunities are created (or not) during the presentations by an expert community member on indigenous practices in relation to the moon, sun and stars?

4. How can Grade 4 Natural Sciences and Technology teachers be supported in planning and developing model lessons on the features of the moon that integrate local or indigenous knowledge?

1.7 Theoretical Framework

The theoretical framework of this study was guided by Vygotsky's socio-cultural theory, while Shulman's (1986) pedagogical content knowledge was used as an analytical framework. Vygotsky (1978) believes that learning takes place through social interactions with materials from people's cultures in their society. Shulman (1986, 1987) states that a teacher needs to present the subject matter knowledge drawing from learners' knowledge, in order to facilitate learning to enhance the understanding of the subject content. Within PCK, the focus was specifically on the five components of Topic Specific Content Knowledge (TSPCK) by Mavhunga and Rollnick (2013) and Mavhunga, Ibrahim, Qhobela, & Rollnick (2016).

1.8 Data Gathering Techniques

Four data gathering techniques were used to gather data for this study. These techniques were:

- Questionnaire;
- Semi-structured interviews;
- Document analysis; and
- Workshop discussions.

1.9 Definition of Key Concepts used in the Thesis

Indigenous Knowledge: A legacy of knowledge and skills unique to a particular indigenous culture and involving wisdom that has been developed and passed on over generations (Kibirige & Van Rooyen, 2006).

Pedagogical Content Knowledge (PCK): A concept which describes the knowledge which teachers have in terms of pedagogy and subject knowledge (Shulman, 1986).

Socio-cultural theory: This is a social learning theory that focuses on how learning occurs as a result of interactions and how culture, cultural beliefs and attitudes affect the interactions (Vygotsky, 1978).

Professional Development: This refers to a wide variety of specialised training where professional learning is expected to take place to improve professional knowledge and skills (Runhaar, 2008; Shabani, 2016).

The moon: is an astronomical body that orbits the Earth as its only natural satellite (South Africa. DoE, 2011).

Natural Sciences and Technology: A subject done in the intermediate phase that is a combination of two subjects which are:

Natural Sciences, which refers to the branch of science concerned with description, prediction, and understanding of natural phenomena, based on empirical evidence from observation and experimentation (South Africa, DoE, 2011).

Technology, which is defined as the use of knowledge, skills, values and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration (South Africa. DoE, 2011)

1.10 Thesis Outline

This thesis is presented in seven chapters which are summarised below:

Chapter One: This chapter presented the context of the study, which included international, regional, as well as the South African context. This was followed by a summary of my experience as a student, teacher and Subject Advisor. This chapter also highlighted the statement of the problem, the rationale, the significance of the study, research goal, objectives and questions and the conceptual and theoretical frameworks. Also, the data gathering techniques were described, followed by the definition of key concepts. Lastly, a summary of the outline of the study was presented.

Chapter Two: In this chapter the relevant literature for the study is discussed. Also, an overview of literature is explored, relating to integration of indigenous knowledge in science around the world and narrowing it down to South Africa. This is where the expectations of the South African Curriculum in terms of integration of indigenous knowledge into science lessons are highlighted. In the third part of this chapter, a comparison between indigenous and western sciences is made. The challenges and benefits of integrating local knowledge, teachers' pedagogical development and their participation in professional development activities are also discussed. Lastly, this chapter presents the description of the theoretical and analytical framework used in this study. It provides an overview and application of Vygotsky's (1978) socio-cultural theory. Lastly, it shows how Mavhunga's (2013) TSPCK components are relevant as the analytical framework of this study.

Chapter Three: This chapter provides an overview of research methodologies used in this study. Firstly, it portrays the research orientation, research approaches, research objectives and research questions. Secondly, the research site, procedures of the study, data gathering techniques and the rationale behind their use are explained. Thirdly and finally, data analysis, data management, validity, trustworthiness, ethical considerations and my positionality are presented.

Chapter Four: In this chapter the results and findings of data gathered from questionnaires and semi-structured interviews are presented in two parts. The first part is the analysis of the data gathered from the background information of the participants. The second part is the analysis of findings of the qualitative data from the questionnaires and semi-structured interviews.

Chapter Five: This chapter provides data presentation, analysis and discussions of the data generated during document analysis and the presentation by the expert community member.

Chapter Six: This chapter presents, analyses and discusses the qualitative data collected from the process of co-development of model lessons and from the teachers' journal reflections.

Chapter Seven: This chapter summarises the findings of the study per research question. It also gives recommendations for further studies, limitations of the study, some personal reflections and ends with the conclusion.

1.11 Chapter Summary

This chapter presented the contextual background of the study, statement of the problem, significance of the study, research goals and objectives, definition of the terms and thesis outline.

It was designed to guide the reader throughout the thesis. The next chapter presents relevant literature to the study.

CHAPTER TWO: LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Introduction

In the previous chapter, I discussed the context of my study. The focus was on exploring an intervention on the development of model lessons on the features of the moon that integrate indigenous knowledge in Grade 4 in the Chris Hani West District. This chapter first provides a brief definition of local or indigenous knowledge. Secondly, it discusses the need for science teachers to integrate local or indigenous knowledge into science lessons. Thirdly, it discusses whether or not integration of IK is being implemented as stipulated in the curriculum. Furthermore, challenges faced by teachers regarding the integration of IK are highlighted and how local knowledge can be integrated when teaching the topic of the features of the moon. Lastly, I discuss the theoretical, the analytical, as well as the conceptual framework which guide this study.

2.2 Local or Indigenous Knowledge

The literature presents indigenous knowledge as *indigenous technology* (Snively & Corsiglia, 2000); *traditional ecological knowledge* (Turner, Ignace, & Ignace, 2000*); indigenous local knowledge* (Atteh, 1992); *indigenous/native science* (Aikenhead, 2006). Building on this, Kibirige and Van Rooyen (2006) define indigenous knowledge as a legacy of knowledge and skills unique to a particular indigenous culture, and involving wisdom that has been developed and passed on over generations.

Parallel to this, Seehawer (2018) defines indigenous knowledge as ways of knowing developed by local or indigenous peoples over generations as a result of sustained occupation or attachment to a place. According to her, such occupancy allows communities to develop a perfect understanding of the relationship of their communities to their surrounding natural and social environments.

Mukwambo (2016) on the other hand, breaks down indigenous knowledge into two words, indigenous and knowledge. According to him, some meanings loaded in indigenous are traditional, local, natural and primitive; whereas knowledge refers to power, a commodity, or a tool that particular local people are armed with. However, for the purposes of this study, indigenous knowledge is understood to include knowledge about agriculture and food production, pastoral practices and animal production, forestry, plant classification, medicinal plants, management of biodiversity, food preservation, management of soil and water, iron smelting, brewing, making dwellings and understanding astronomy (South Africa. DoE, 2011). More so, this study used local knowledge and indigenous knowledge interchangeably.

Local or indigenous knowledge manifests through, among other things, language, beliefs, values, customs, institutions, technologies, education, artefacts, games, food, rituals and ceremonies (Gadzirayi, Mutandwa, Chihiya, & Chikosha, 2006), and elders are the custodians of this knowledge. As custodians of local or IK, elders are regarded as educators of children, youth, and adults and are communities' storytellers and historians, whose stories are used as educational tools to sustain communities' cultures and traditions (Iseke & Brennus, 2011). Hence, in this study, I refer to them as more knowledgeable others (MKOs) (Vygotsky, 1978). Even so, Nakata and Langton's (2009) study revealed that the number of elders who have a considerable amount of oral knowledge is diminishing. They recommended that there is a need for the elders' knowledge to be documented. Hence, this study has collaborated with expert community members who are knowledgeable about IK and local practices and this has afforded me the opportunity to document some of the local or indigenous knowledge and make it available in local schools, so that teachers are able to integrate it when teaching Natural Sciences.

2.3 The Need to Integrate IK in South African Science Curriculum

Integration of indigenous knowledge into science lessons is regarded by some scholars as a positive step that could provide opportunities for debate on interaction between western and indigenous worldviews (Battiste, 2005; Kincheloe & Steinberg, 2008; Mushayikwa & Ogunniyi, 2011). Aikenhead and Jegede (1999) suggest that IK can be used to enable border crossing between home and school science. Furthermore, in a study conducted by Sedlacek and Sedova (2017), it

was revealed that integration of local or indigenous knowledge increases learners' participation in classrooms. Kibirige and van Rooyen (2006) on the other hand, posit that science teaching is enriched when IK is used as indigenous prior knowledge in the classroom and can thus be used as a starting point to explore concepts associated with westernised science (WS). Building on the findings of Kibirige and van Rooyen (2006), Brayboy and Castagno (2008) consider the integration of IK in science as not only connecting science to indigenous students' lives, but also creating better scientist and students with stronger critical thinking skills.

Adding to these benefits, George (1999) notes that indigenous knowledge could play a worthwhile role in environmental management. Similarly, Dei (2000) asserts that indigenous knowledge holds significant possibilities for social and ecological sustainability because "ecological unity focus on the responsible use of land and natural resources according to the principles of sustainability" (p. 79). He adds that indigenous knowledge could also educate the exploiters of natural resources on how environmental integrity should be respected, honoured, and valued (Dei, 2000). Semali and Kincheloe (1999) posit that indigenous knowledge could make a significant contribution in cultural revaluing among indigenous peoples. They thus call for a more inclusive reconceptualised curriculum practice which is inclusive, democratic, and one which acknowledges African heritage, experience, identity, and history (Semali & Kincheloe, 1999).

Amidst the benefits of integration of local or indigenous knowledge as suggested by some scholars, literature reveals that there are some shortcomings. Scholars such as Cobern and Loving (2001), argue that IK should not be seen as the solution to the teaching of science, as some problems may arise when it is integrated in teaching. To elaborate more, Le Grange (2007) posits that learning using IK may cause cognitive conflicts or dissonance between scientific language and everyday language. This is because learners have to replace their existing knowledge with the new knowledge that they are acquiring through schooling. To Le Grange (2007), learners might have problems in using the scientific concepts which are required from them in the classroom. For instance, learners might use everyday language to answer questions in the examination and this might lead to them losing marks, as they are required to use scientific concepts (Haimene, 2018). At the same time, Mukwambo et al. (2014), also allude to the fact that most science concepts are not yet developed in the indigenous language and science concepts are not always explicit in most

indigenous practices, yet the Africanisation of the school science curriculum calls upon the teachers and learners to attach scientific explanations to IK. They believe that the Africanisation of the science curriculum may allow more examples of indigenous knowledge to be used in the classroom (Mukwambo et al., 2014).

2.4 Implementation of Integration of Local or IK in Science Classrooms

Notwithstanding the calls for science curriculum which acknowledges African heritage, Semali and Kincheloe (1999) note that the science that is taught in Africa, does not carry the African identity and the indigenous ways of knowing are not recognised by the teachers. In line with this finding, Wangola (2002) contends that indigenous knowledge is not well acknowledged and supported in the African education system because westernised science (WS), culture and values are regarded as powerful and significant. Breidlid and Botha (2015) added that "the indigenous knowledges are looked down upon in the classroom context and viewed as irrational and backwards, thus creating, like in South Africa, alienation and cultural and epistemological disillusionment among the children of indigenous communities" (p. 333). The same observations were made by Shinana (2019) in her study conducted in Namibia. In this study, she commented that science content in Namibian classrooms is taught in decontextualised ways. This, according to her, leads to poor comprehension of science content.

Mukwambo (2016) claims that even though IK is shunned in some contexts, WS however, is extracted and still extracts and appropriates some ideas from IK from all areas of the world. Parallel to this, Le Grange (2007) warns that teachers should not ignore learners' prior knowledge as their learning is embedded in their socio-cultural environment (Mavuru & Ramnarain, 2017), which plays a major role in learning of science in the classroom. In this regard, Nyika (2017) stresses that what learners learn from their homes or from their culture, can be used in the classroom as the foundation for learning new concepts. The learners' socio-cultural backgrounds which they bring to the classroom, should be used as prior knowledge during teaching of Natural Sciences. This implies that Natural Sciences teachers must be aware of learners' socio-cultural factors which influence science learning. In the context of this study, language, ideas, beliefs, customs, taboos, rituals, ceremonies, *storytelling*, artefacts and traditions, are amongst the socio-cultural factors

which influence the learning of sciences. This study focussed on the role of language and *storytelling* in science teaching.

2.4.1 Language

Language plays a crucial role in the transmission of local or indigenous knowledge (Battiste, 2005). Masondo (2013) concurs with this notion, as he asserts that language communicates the traditions, customs, morals and values of a people. In the Chris Hani West District where this study was conducted, the medium of instruction in the majority of schools is English. Of course, there are some schools who offer dual medium instruction, in that case, the medium of instruction would be English and Afrikaans. There is a pilot programme of Mother Tongue Based Bilingual Education (MTBBE) which started in 2017, whereby Mathematics and Natural Sciences (NS) are taught in IsiXhosa. This was piloted to a selected 10 schools in Komani CMC and introduced in Grade 4.

Currently in those schools it is also being implemented in Grade 6. However, English still prevails as the language of teaching and learning in NS, particularly affecting those in township and rural schools "where there are learners who lack English language proficiency to fully engage with curriculum in the classroom" (Mavuru & Ramnarain, 2019, p. 2). In circumstances like these, teachers tend to use learners' home languages to explain scientific concepts for meaningful learner understanding (Probyn, 2009). In science classrooms in most rural and township schools, there is what Mavuru and Ramnarain (2019) call a "cultural clash", wherein the learners' home language and culture encounters the culture of science as encapsulated in the western worldview (Cobern, 1998). My study also observed that although the curriculum calls on teachers to integrate local or indigenous knowledge in their classrooms, they encounter multiple challenges in doing so. Yet, one of the strategies used by indigenous people to transmit knowledge is *storytelling* (Iseke, 2013; Tzou, Meixi, Suárez, Bell, LaBonte, Starks & Bang, 2019).

2.4.2 Storytelling

Storytelling is a practice in indigenous cultures that sustains communities and validates the experiences and epistemologies of indigenous peoples (Iseke, 2013; Tzou et al., 2019). Iseke

(2013) further states that *storytelling* provides opportunities to express the experiences of indigenous peoples in indigenous languages and nurtures relationships and the sharing of indigenous knowledge and cultures. *Storytelling* was also used by my grandparents and elders in my community to pass down important and meaningful information; for instance, they would narrate folk *stories* to us aimed at passing down principles, values, and beliefs. What was fascinating is how my grandparents encouraged us to take responsibility for listening, interpreting, and reflecting upon *stories*. We would sit around the fire in a circle format and this encouraged discussion and ensured opportunities for full participation by everybody (Vygotsky, 1978; Sedlacek & Sedova, 2017). Using *storytelling* according to Iseke (2013), is a pedagogic tool for learning about life. Concurring, Tzou et al. (2019) accentuate that *storytelling* is vital in presenting and making visible other ways of knowing and being. For the purpose of this study, *storytelling* was thus be used by an expert community member to share his local or indigenous knowledge on features of the moon which subsequently teachers had to integrate into their lessons with a view to make science relevant and accessible to their learners.

2.5 Challenges Faced by Educators in Integration of Local or IK in Science Lessons

Poor departmental support for teachers, weak support of teacher training, the lack of enough support materials, and the general lack of resources, negatively affect the integration of local or indigenous knowledge into science lessons (Seehawer, 2018). To Seehawer's (2018) observation, indigenous knowledge is hardly specified in the curriculum and the teachers do not necessarily have IK themselves. In my experience as a teacher and currently the Subject Advisor, I also observed that in the Department of Education the professional development infrastructure is inadequate. There is a lack of fully equipped department officials with skills that will enable them to meet the educators' pedagogical needs. The issue of support of teachers by district officials is also deemed by Akiba and Liang (2016) as critical for critical improvement of their knowledge instruction and student learning. It is based on such reasons, that this study engaged Natural Sciences and Technology teachers in the form of continuing professional development, so as to equip them with examples of local or indigenous knowledge and how they can integrate it in their science lessons.

Most Natural Sciences and Technology teachers have only been exposed to western science and have not been exposed to any IKS training. In line with Garet, Porter, Desimone, Birman and Yoon, (2001) my study suggest that professional development and in-service training should be for teachers to become actively engaged in meaningful discussion, planning and practice, particularly how the new curriculum materials and teaching methods will be used in the classroom. According to these authors, this active learning would include opportunities to link ideas introduced during professional development experiences to the teaching contexts in which teachers work. The workshop discussions planned for this study, were therefore aimed at affording teachers opportunity for active engagement so as to get an understanding of what IK is and how best we can include it in our classrooms.

As stated earlier, shortage of the learning and teaching support material is another challenge regarding the integration of local or indigenous knowledge into science lessons. Khuphe (2014) states that indigenous knowledge is not documented and is not readily available to teachers. Lubben (2011), on the other hand criticises the textbooks designed for science teachers, claiming that they do not accommodate the diversity of environments in the South African context, leaving teachers with very little material to support them. According to George (1999), indigenous knowledge is not included in most school teaching and learning materials. Indigenous knowledge is not documented and is not readily available to teachers. Kibirige and Van Rooyen (2006) state that the science textbooks used in school science curricula sometimes do not consider indigenous knowledge or other forms of knowledge. It is also not clear from the curriculum documents how local/traditional knowledge (indigenous knowledge) is supposed to be included in the science lessons, to make for meaningful teaching and learning.

Concurring, Diwu and Ogunniyi (2011) revealed that many teachers are of the opinion that some text books are not helpful to indigenous learners. However, it is worth noting, that the diversity of cultures from one community to another will mean that the teaching materials developed for one community might not be transferable to another community.

Adding to the challenges brought by integration of local or IK science content, Nyika (2017) brings forward the challenges of pedagogy. In his study, he revealed the issue of the diversity of schools

and science classrooms in the present South African context. Admittedly, South African schools are filled with learners from diverse cultural backgrounds which become a challenge for teachers (Mavuru & Ramnarain, 2017; Nyika, 2017) as each learner has their own home experience which the teacher needs to build on. This is a result of migration of people from neighbouring countries and their children enrolling in South African schools.

Oloruntegbe and Ikpe (2011) highlight the importance of training teachers on how to improve the use of learners' home experiences in such a way that they may clearly see the connections between the home experiences and school science. On the other hand, Oloruntegbe and Ikpe (2011) and Le Grange (2008) believe that science teachers, textbook authors, teacher trainers and curriculum planners need to create opportunities for establishing a bridge between school science and household chores. This means empowering the teacher to be able to represent and formulate the subject in a manner that makes it comprehensible for the learner (Shulman, 1986, 1987). For now, the curriculum does not give that freedom to the teachers to include or test the knowledge from home (IK). My belief is, that teachers need to improve their understanding about local or indigenous knowledge for them to be able to integrate it into the curriculum. As a Senior Education Specialist (SES) or Subject Advisor, my focus is on continuing professional development of teachers, hence I came up with an intervention that will support Grade 4 teachers to integrate local or IK in their Natural Sciences and Technology lessons. This study thus sought to collaborate with Natural Sciences and Technology teachers, so as to document the local knowledge in the Chris Hani West district and hence develop model lessons that integrated local or indigenous knowledge in the topic of the features of the moon.

2.6 The Topic of the Features of the Moon

The features of the moon is one of the topics under the knowledge strand The Planet Earth and Beyond. Of the four knowledge strands done in Natural Sciences and The Technology, Planet Earth and Beyond is the strand that teachers struggle to teach, since it requires teachers to have a deep knowledge of Geography. Moreover, it seems the majority of Natural Sciences teachers especially in the Chris Hani West District, have not studied Geography as their major subject. As a result, most of them have indicated that they have problems in mastering this knowledge strand.

This poses a challenge, especially in teaching the topic on the moon. Several problems are also encountered on the learners' side. Benacchio (2001) attributes some of these problems to the fact that most children in developed countries are living in light polluted areas, which makes the night sky not clearly visible.

When teaching this topic, the CAPS document stipulates that learners should be able to interpret pictures and models of the moon. Additionally, learners should make drawings or models of the moon and observe and record the changing shape of light on the moon each night for at least a month (South Africa. DoE, 2011). I have always observed as a teacher and a Subject Advisor that because of the complexity of this topic, teachers tend to use passive methods of teaching. As I mentioned in Chapter One, I have not come across any study that discusses how this topic should be taught. This study thus aimed at bridging such gaps; essentially, its primary focus being the co-development of model lessons that integrated local or indigenous knowledge in the topic of the features of the moon in particular. It is hoped that through this small scale intervention, Natural Sciences and Technology teachers in Komani CMC might be able to develop their own model lessons that integrate IK in other topics as well. This suggests that there is a need for professional development or professional learning communities for Natural Sciences and Technology teachers.

2.7 Professional Development

Professional development is regarded as "a cultural practice engaged in by participants of various communities, a collaborative praxis in which participants are involved in negotiating meaning and developing improved understandings in professional communities of learning"(Ngcoza & Southwood, 2019, p. 5). This seems to suggest that in professional development, there has to be an active involvement of educators in an ongoing process of professional learning and growth. Both definitions resonate well with the main goal of this study where I, as the researcher, will work collaboratively with the teachers to develop model lesson plans that integrate IK in the topic of the moon. Ngcoza and Southwood (2019) further emphasise that professional development is a concept of development that is *about* educators, *for* educators, *by* educators, *with* educators. As Asheela (2017) further elaborates, that professional development is not always confined to formal platforms but can also occur informally such as during discussions with work colleagues,

independent reading and research, learning from a peer and observations of a colleague's work. Thus, this study aimed at opening opportunities for teachers to work in professional learning communities, to develop further model lessons that integrate IK in other topics.

A number of scholars recommend that many problems facing science teaching and learning today could be resolved through professional development (e.g. Ngcoza, 2007; Shizha, 2007; Ogunniyi & Ogawa, 2008). However, for teachers to improve their practice they need to get particular assistance. Eun (2008) explains that teachers should first be provided with materials resources, for example, textbooks and classroom materials to enhance changes in their teaching environment. Vygotsky (1978) terms these tools as mediatory tools which aid the learning process. In the context of my study, presentations about the local cultural activities by the expert community member, document analysis and the co-development of lesson plans are part of professional development. How the community member presents and the suggestions on how the cultural activities could be incorporated or integrated in teaching of Natural Sciences, are used as both a representation (Mavhunga & Rollnick, 2013) and a mediatory tool. The representation and mediatory tool are both used to support the teachers in developing understanding of indigenous knowledge and how it should be integrated when teaching the topic of the features of the moon in Grade 4 classes.

The Department of Education has opened a new section called Teacher Development, whose focus is mainly on the professional development of in-service educators. It is this section that encourages educators to register with the South African Council of Educators (SACE) online system, where teachers are awarded continuing professional teacher development (CPTD) points for each workshop they have taken part in. As this study is in the form of an intervention, it is hoped that it might afford opportunity for teachers to be awarded CPTD points.

While the issues of professional development and availability of resources can be cited as hindrances in the integration of IK in science lessons, it is believed that teachers' views towards the inclusion of IK also play a significant role (Ogunniyi & Hewson, 2008; Govender, 2014; Cronje, de Beer, & Ankiewicz, 2015). Thus, Ogunniyi (2007) states, that for the successful implementation of IK in science classrooms, it is important to help teachers understand the nature of science and the nature of indigenous knowledge systems (IKS). This could be done by engaging

science teachers in long-term mentoring and dialogue, to show them how to translate knowledge of the two systems into classroom practice (Ogunniyi, 2007).

2.8 Theoretical and Analytical Framework

The theoretical framework of this study was guided by Vygotsky's socio-cultural theory, while the Topic Specific Pedagogical Content Knowledge (TSPCK) was used as an analytical framework. I now discuss these below.

2.8.1 Theoretical framework

Socio-cultural theory describes learning and development as being embedded within social events and occurring as a learner interacts with other people, objects, and events in the collaborative environment (Vygotsky, 1978). To Vygotsky (1978), learning has its basis in interaction with other people. That is, socio-cultural theory focuses not only on how adults and peers influence individual learning, but also on how cultural beliefs and attitudes impact how instruction and learning take place. The socio-cultural theory informed this study in terms of learning, by looking at how teachers can learn in a social cultural context and relate socio-cultural knowledge to the subject content knowledge. Socio-cultural theory has many concepts that include among others, culture, language and mediation, internalisation, self-regulation, social interactions and Zone of Proximal Development (ZPD). However, this study will only focus on, *mediation of learning*, *social interactions* and *the zone of proximal development* (ZPD). I now discuss each of these below as they will be used as key concepts.

2.8.1.1 Mediation of learning

According to Vygotsky (1978), mediation involves the use of cultural tools such as language and materials to achieve the learning goal. Mediation is regarded by Shabani (2016) to be central in learning. Vygotsky's (1978) mediation linking triad in the Figure 2.1 below helped me to unpack the mediation process.

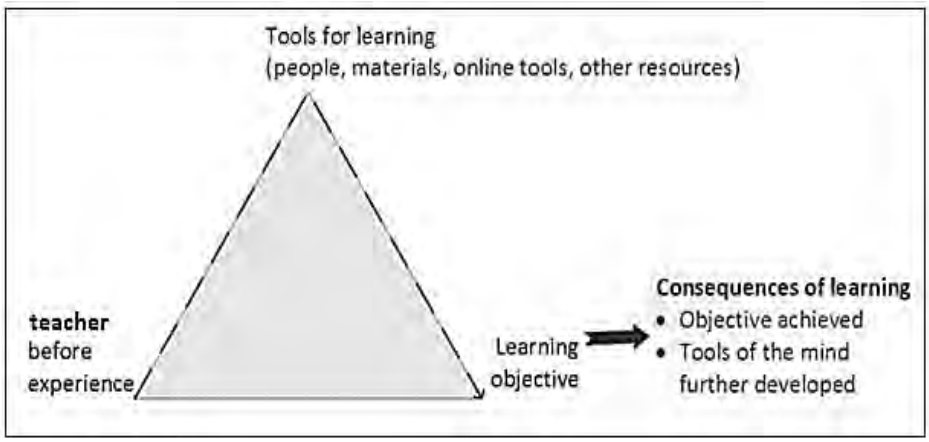


Figure 2.1: Shows mediation linking triad (Adopted from Vygotsky, 1978, p. 54)

For instance, during the intervention process the first step was to find out Grade 4 Natural Sciences and Technology teachers' experiences, perspectives, and pedagogical insights on the integration of local or indigenous knowledge in science lessons. This is what is referred to in the above figure as '*teacher before the experience'*. Secondly, teachers co-analysed the curriculum documents and during this process they communicated using language, textbooks, and other resources as cultural tools. The expert community member also used language and folk *stories* related to the moon as mediating tools (tools for learning). This is in line with Iseke (2017) who accentuates that *storytelling* is a pedagogic tool for learning.

It was hoped that after the teachers were involved in the intervention, they would be able to plan and co-develop model lessons on the features of the moon that integrate local or indigenous knowledge (consequences of learning). As Eun (2008) suggests, learning and development should not be restricted to children only. He argues that learning and development are essential for both children and adults, especially teachers in the context of my study. Concurring, Shabani (2016) posits that learning in school is applicable to teachers in order to help them to grow in their work place.

My study looked at the interactions and the mediation processes that occurred during the presentation by the expert community member and during the development of model lessons.

Vygotsky (1978) further states that cognitive development is not a direct result of activity, but it is indirect. This means, other people must interact with the learner using mediatory tools to facilitate the learning process, and then cognitive development may occur. To Martin (2008), cultural tools can be conceptual, material, organisational, as well as language. Similar to Asheela's (2017) study, in this study the language was one of the cultural tools that was used during the presentation by the expert community member and during the process of development of model lessons intervention. As discussed previously, language communicates the traditions, customs, morals and values of a people (Masondo, 2013). Without language, it would be impossible to socialise and interact because language is regarded as a vital cultural tool through which learning and thinking is shaped (Mika, 2018). Notable, is that in this study the concept of mediation of learning was realised during the presentation by the expert community member, who according to Vygotsky (1978) is the more knowledgeable other (MKO) in this case.

2.8.1.2 Social interactions

Socio-cultural theory focuses on the learner as a product of social interactions, especially with adults (parents, teachers) and peers. This suggests that it is through collaborative activities with more skilled persons that learners learn and internalise new concepts, psychological tools, and skills. In this study, learners were teachers who participated in this study and the adult was the expert community member, of whom Vygotsky (1978) refers to as the more knowledgeable other (MKO). In the context of this study, social interactions took place during discussions when teachers were doing document analysis and when they collaboratively developed model lessons.

Essentially, this study took the view that construction of knowledge in the Natural Sciences and Technology does not exist in a social vacuum, but instead exists within a socio-cultural milieu. In consequence, there is a need to pay attention to the cultural issues regarding knowledge. Socio-cultural theory will therefore be appropriate for analysing how teachers can learn to improve their teaching practices by integrating IK in the lesson on the topic of the features of the moon. It is hoped that this might ultimately shift their learners' zone of proximal development.

2.8.1.3 Zone of Proximal Development (ZPD)

To Vygotsky (1978), the Zone of Proximal Development (ZPD) "is the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance or in collaboration with more capable peers" (p. 86). Essentially, the ZPD entails all of the knowledge and skills that a person cannot yet understand or perform on their own, yet are capable of learning with guidance. As learners are allowed to stretch their skills and knowledge, often by observing someone who is slightly more advanced than they are, they might be able to progressively extend their ZPD. Although the ZPD is normally used with reference to how children learn, my study will use this concept in teacher development, wherein the focus will be on teachers. In the context of this study, the ZPD of teachers is their understanding of IK and how it can be integrated into the topic of the moon. Through the presentation by the expert community member, who is the more knowledgeable other, and through the intervention, teachers will be able to co-develop model lessons that integrate IK in the topic of the moon, that they will be able to implement in their classrooms.

2.9 Analytical Framework: Pedagogical Content Knowledge

The notion of Pedagogical Content Knowledge (PCK) as attributed to Shulman (1986) is described as "the capacity of a teacher to transform the content knowledge he or she possesses into forms that are pedagogically powerful" (p. 15). That is, how the teacher presents the subject matter knowledge (SMK) in a way that ensures epistemological access, drawing on examples from learners' socio-cultural contexts to facilitate learning to enhance understanding of the subject content and basic scientific terminology (Mavuru & Ramnarain, 2017). Shulman (1986) also believes that PCK is the knowledge that teachers develop over time and through experience, about how to teach particular content in particular ways in order to enhance learners' understanding (Shulman, 1987). PCK focuses on the knowledge of what method or teaching strategy would be most suitable to ensure student understanding of a certain topic (Motthwa, 2011). Natural Sciences and Technology teachers are expected to have an in-depth knowledge of the NSTECH content to be taught to learners. Motthwa (2011) further states that teachers are expected to have knowledge

that stretches beyond the knowledge found in text books. Teachers should know the students and the environment they come from. This, according to Shulman (1986) and Sanders (2007), will enable teachers to understand and anticipate misconceptions that learners might encounter on specific topics. This implies that science teachers should have general pedagogical approaches which are suitable for each specific topic in Natural Sciences.

Sanders (2007) explains pedagogical content knowledge (PCK) as integrated science knowledge, pedagogical knowledge and context knowledge. According to Sanders, these three must be combined in order to give learners a proper insight of the knowledge. This is shown in Figure 2.2 below.

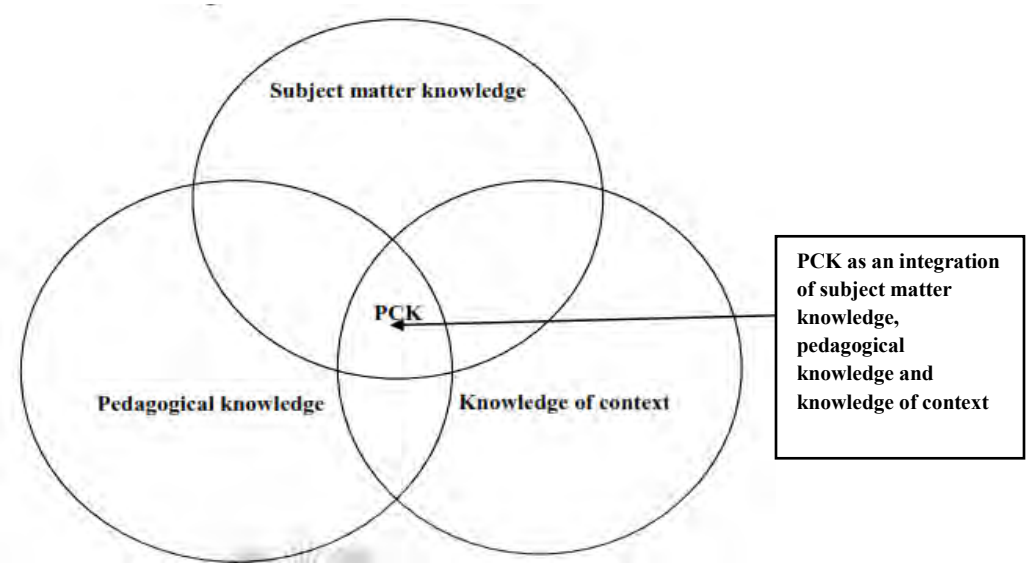


Figure 2.2: PCK combines subject matter knowledge, pedagogical knowledge and context knowledge (Motthwa, 2011, p. 41)

PCK differs from topic to topic (Shinana, 2019), so the focus of my study was on PCK within the topic the Moon in Grade 4, hence, I adopted Mavhunga and Rollnick's (2013) Topic Specific Pedagogical Knowledge (TSPCK) as an analytical tool. Topic specific PCK (TSPCK) is regarded as an understanding that provides the needed knowledge for content knowledge (CK) transformation in a particular topic (Mavhunga & Rollnick, 2013). Five knowledge components

of TSPCK are identified as the enablers that transform subject matter knowledge and these are (1) learners' prior knowledge; (2) curricular saliency; (3) what is difficult to teach; (4) representations (including powerful analogies); and (5) conceptual teaching strategies. These intertwined components are further summarised in Figure 2.3 below.

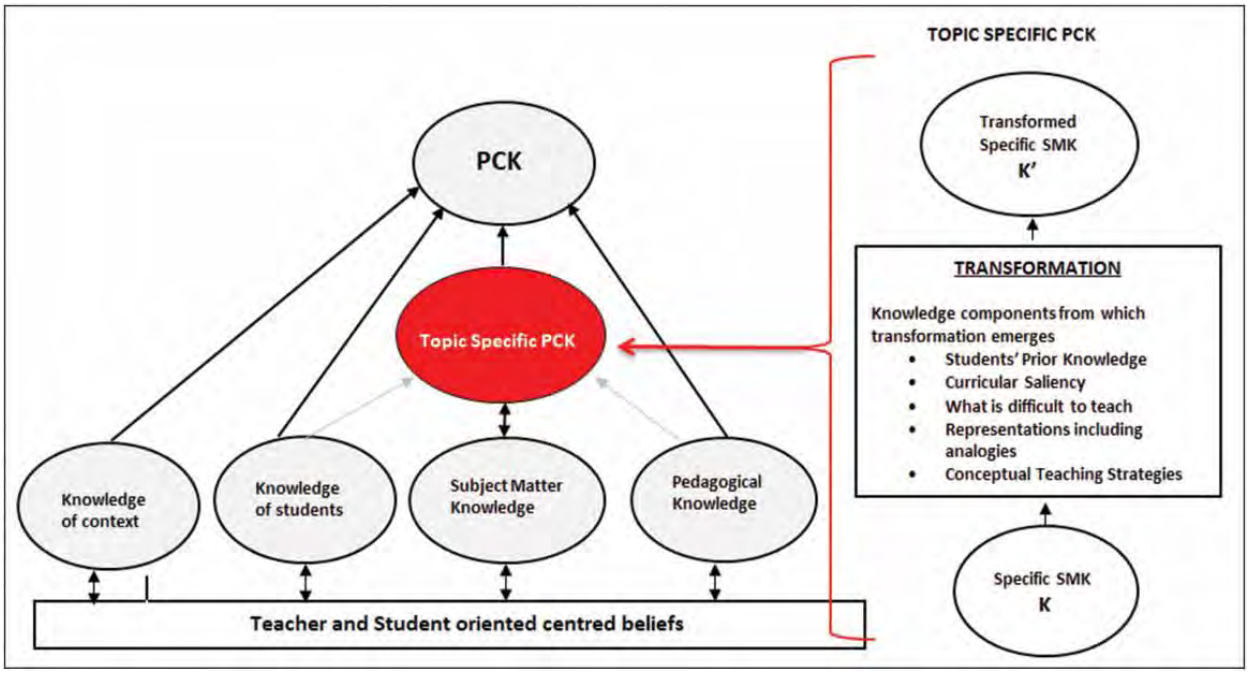


Figure 2.3: Shows a model of components of TSPCK (Mavhunga & Rollnick, 2013, p. 115)

(a) Learners' Prior Knowledge

According to Mavhunga et al. (2016), this component involves elicitation of learners' prior knowledge and paying attention to their misconceptions. Mavhunga et al. (2016) further state, that this component also requires the teacher to have the skill of being able to handle the misconceptions learners might have. It also includes understanding of knowledge that learners might have as a result of prior teaching, before teaching the new concepts. This study made use of the questionnaire and semi-structured interviews to elicit learners' prior knowledge, who were in this case the participating teachers. These tools were used to find out teachers' perspectives, understanding and pedagogical insights on the integration of IK into science lessons.

(b) Curricular saliency

This component refers to the identification of the most important meaning of major concepts of a topic, without which understanding of the topic would be difficult for learners (Mavhunga & Rollnick, 2013). It also includes the knowledge of how to logically sequence the learning and knowledge of pre-concepts needed prior to teaching a topic (Mavhunga et al., 2016). Similarly, Shinana (2019) emphasises that this component demands that the teacher identifies the major concepts around the topic (the big ideas), and the prerequisite concepts learners need to know before the topic is presented. In the context of this study, this component entailed teachers finding concepts that would make teaching of the topic of the moon difficult. This was done when teachers co-developed model lessons.

(c) What is difficult to teach

Mavhunga et al. (2016**) r**efer to gatekeeping concepts which are difficult to understand, often because they cause conflict with previously established understanding 'what is difficult to teach'. As suggested by Mavhunga et al. (2016), this component describes teachers' insights into the concepts within a topic that are difficult to teach, for example, the misconceptions which learners have that could possibly hamper their understanding.

As already discussed in Section 2.1, the topic of the features of the moon is one of the important natural sciences topics under the knowledge strand The Planet Earth and Beyond. It is also known to be a fundamental topic in understanding other subtopics such as the phases of the moon, lunar eclipse, and solar eclipse.

(d) Representations and conceptual teaching strategies

According to Mavhunga and Rollnick (2013) and Mavhunga et al. (2016), representations refer to how learning content should be presented in such a way it carries meaning to the learners. Shinana (2019) suggests this can be achieved using aids that teachers consider having potential to support the teaching of content. The component of conceptual teaching strategies on the other hand, is referred to as teaching strategies derived from the considerations made from the other four

components and excludes general teaching methodologies (Mavhunga et al., 2016). Within these two components, this study focused on what teaching and learning activities could be used by teachers when teaching the topic of the features of the moon.

2.10 Chapter Summary

I this chapter, I discussed the literature in relation to the calls to integrate indigenous knowledge into the curriculum focusing on international and African contexts. Secondly, I discussed the underlying principles of the South African curricula with regards to indigenous knowledge, from Curriculum 2005 until the current Curriculum and Assessment Policy Statement (CAPS). Thirdly, I discussed the literature pertaining to the hindrances to integration of IK into science lessons. At the same time, the benefits and challenges of integration of indigenous knowledge into science lessons was discussed. Thereafter, I discussed the conceptual framework with the focus on the key concepts of pedagogical content knowledge and professional development.

Lastly, I discussed Vygotsky's socio-cultural theory (1978) as a theoretical framework that informed my study; where I focused on the concept of mediation of learning, social interactions and the zone of proximal development.

In the next chapter, I discuss the research design and methodology used to generate data for this study.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

In this study, I explored an intervention on development of model lessons that integrated local or indigenous knowledge in the topic of the features of the moon in Grade 4 classes. In this chapter, I thus elaborate on the methodology adopted in my study. To begin with, the research design and orientation are explained. A profile of the research objectives, goal and questions follows. Thereafter, a narrative of the research site and participants, as well as data gathering and analysis techniques are provided. Finally, the validity and ethical issues which were taken into consideration are discussed. The chapter ends with a chapter summary.

3.2 Research Design and Methodology

This section briefly explains what research design and research methodology are. It also explains the paradigm in which this study was underpinned.

3.2.1 Research design

Bertram and Christiansen (2015) explain that the research design is the plan of how the research should be carried out and how the data collected should be analysed in order to answer the research question(s). Bertram and Christiansen (2015) further highlight, that a research design should clearly state what the research will do with the data after the process of data collection. Similarly, Cohen, Manion and Morrison (2018), explain that a research design is a plan or strategy that is drawn up for organising the research, and making it practicable, so that the research questions can be answered based on evidence. In a similar manner, this study is underpinned by an interpretive paradigm.

Cohen et al. (2011) state that the interpretive paradigm has to do with understanding human experiences from within the individual's intentional behaviours and actions. Furthermore, the interpretivists view the social world as an emergent social process, which is created by the individuals concerned through experiences (Cohen et al., 2018). The interpretivists aim to understand the meaning which informs human behaviour and to make "interpretations with the purpose of understanding human agency, behaviour, attitudes, beliefs and perceptions" (Bertram & Christiansen, 2015, p. 26). In this study, an interpretive paradigm helped me as the researcher to better understand teachers' experiences, their perspectives as well as pedagogical insights on the integration of local or indigenous knowledge when teaching the topic of the features of the moon in Grade 4 classes. It also helped me to understand the nature of support required by the teachers to be able to develop model lessons that integrate local or indigenous knowledge on the topic of the features of the moon, which was the final product of this study.

An interpretive paradigm was also deemed relevant in the sense that data gathering techniques used such as observations and interviews, are typical techniques associated with the interpretive paradigm. Thus they were suitable methods to collect data in order to answer my research questions.

Within the interpretive paradigm qualitative data were collected, hence a qualitative case study was adopted. Case studies look at what it is like to be in a particular situation, and so they are generally descriptive in nature (Bertram & Christiansen, 2015; Creswell, 2012; Maree, 2014). A case study also provides a researcher with a deeper understanding of the dynamics of a situation (Maree, 2014). Furthermore, a case study provides a full and thorough understanding of particular lived experiences of participants (Bertram & Christiansen, 2015). A case study was therefore appropriate for this study, since my case in this study was to explore the opportunities for integration of local knowledge and practices into Grade 4 lessons on the topic of the features of the moon. My unit of analysis was how Grade 4 Natural Sciences and Technology (NSTECH) teachers co-develop model lessons on the topic 'The Moon' that integrate local knowledge. The focus here is on the teachers' topic specific pedagogical content knowledge (TSPCK). The

participating NSTECH teachers were selected from four schools in the Komani district, which was the research site for the study.

3.2.2 Research site, participants and sampling

The research was carried out in the Chris Hani West District of the Eastern Cape Province. THe Chris Hani West District is one of the 12 districts in this new Service Delivery Model (SDM). It is comprised of three districts, Komani (formerly known as Queenstown district), *Inxuba Yethemba* (formerly known as Cradock district) and Cacadu (formerly known as Lady Frere district). The four participants in this study were Natural Sciences and Technology teachers from four different schools in the Komani CMC. The profiles of these teachers is tabulated in Section 4.2. The choice of these teachers was on the basis of them teaching NSTECH in Grade 4. The choice of Grade 4 was made, based on the fact that it is the entry point of the intermediate phase. I therefore wanted to work with Grade 4 teachers to find out how they could be supported in order to be able to integrate IK into NSTECH topics. Cohen et al. (2018) refer to this as purposive sampling and define it as a sampling method, whereby the researcher chooses a specific sample for a particular purpose. Also, in line with this notion, these teachers were selected based on their location, the *Isibane* circuit, which was geographically close to me, ensuring they were easily available when needed. It is worth noting, that my initial plan was to work with all these teachers, but one teacher withdrew after completing the questionnaire due to work commitments. Therefore, after the questionnaires were completed, three teachers volunteered to participate in the semi-structured interviews and the workshop.

The sample size in this study was relatively small because the aim of this study was not to generalise the findings to a larger population, but to understand the NSTECH teachers' experiences, perspectives and pedagogical insight on the integration of IK into science lessons. Also, to work with them as a community of practise in developing model lessons that integrate local or IK in the topic of the features of the moon.

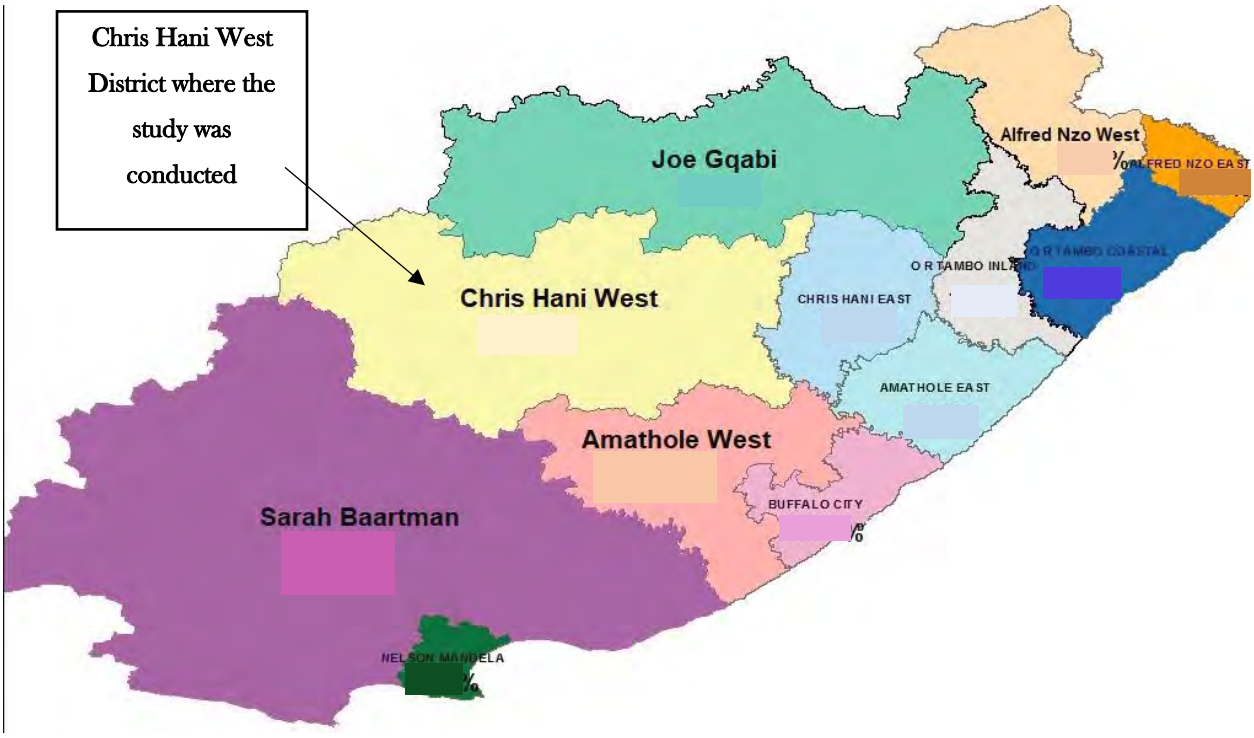


Figure 3.1: Shows Eastern Cape Province map with new 12 districts (https:www.ecdoe)

3.2.3 Research goal, objectives and research questions

The goal of a study outlines what the study is aiming to achieve. In this section, the goal of this study, the objectives and the research questions that helped this study to achieve its goals are discussed.

3.2.3.1 Research goal

The main goal of my study was to explore an intervention on development and implementation of model lessons on the features of the moon that integrate IK in Grade 4 classes. To achieve this goal, the following objectives and research questions guided this study:

3.2.3.2 Objectives

1. To find out Grade 4 Natural Sciences and Technology teachers' experiences, perspectives and pedagogical insights on the integration of indigenous knowledge in science lessons.
2. To determine lessons that Grade 4 Natural Sciences and Technology teachers can learn (or not) through co-analysing curriculum documents?
3. To explore the learning opportunities that are created (or not) during the presentations by an expert community member on indigenous practices in relation to the moon, sun and stars.
4. To plan and co-develop model lessons on the features of the moon that integrate local or indigenous knowledge.

3.2.3.3 Research questions

This study will thus be guided by the following research questions:

1. What are Grade 4 Natural Sciences and Technology teachers' experiences, perspectives and pedagogical insights on integration of local or indigenous knowledge in science lessons?

2. What lessons can Grade 4 Natural Sciences and Technology teachers learn (or not) through co-analysing curriculum documents?

3. What learning opportunities are created (or not) during the presentations by an expert community member on indigenous practices in relation to the moon, sun and stars?

4. How can Grade 4 Natural Sciences and Technology teachers be supported in planning and developing model lessons on the features of the moon that integrate local or indigenous knowledge?

3.2.4 Positionality

According to Sultana (2007), “it is critical to pay attention to positionality, reflexivity, the production of knowledge and power relations that are inherent in a research process in order to undertake ethical research” (p. 380). Sultana suggests that researchers have to be explicit about their interests, personal circumstances, uncertainties and allegiances in the study undertaken. In my case, I was conducting this study as a Subject Advisor (a supervisor to participants of this study), as well as a Master’s degree student (a senior in terms of qualifications), which I believe could affect this study in terms of positionality.

Firstly, I clearly explained to the participants that no one was coerced to participate in my study. Participation was purely voluntary. I explained to them the purpose of the study. I also explained my status as a Subject Advisor, that even though I was new in my job, after having been a teacher in the same district (Chris Hani West) I was in no way a foreigner to them. I placed emphasis on the fact that I was not doing research on them, but I would be doing research with them. They had the freedom to express themselves without being intimidated by my presence. I thus presented myself as a co-learner with them, as I was not aware of any in-service workshop by my predecessors on integration of IK into science lessons. Therefore, this workshop would be beneficial to all of us. Lastly, I grew up in the small town of Cala and I worked with teachers who were born and bred in Queenstown, whom I believe, had in-depth knowledge of local or IK and practices in the Queenstown area. This suggested that I was a co-leaner in this study, as Ogunniyi and Ogawa (2008) assert that IK differs from place to place.

3.3 Data Gathering Techniques

In this study, data were gathered using a variety of data collection techniques such as questionnaires, semi-structured interviews, workshop discussions and journal reflections.

3.3.1 Questionnaire

According to Bertram and Christiansen (2015), a questionnaire is a list of questions that have to be answered by the participants. Furthermore, Bertram and Christiansen (2015) state that

questionnaires allow large numbers of people to answer questions and can reach a large group of geographically spread-out respondents within a short period of time. However, the sample of my study consisted of four teachers and the questionnaire was given to all four of them. An open-ended questionnaire adapted from Webb (2013) was used (see Appendix G). The challenge with questionnaires, however, is that the researcher is not always present to ensure that respondents understand the questions (Bertram & Christiansen, 2015). To counteract that, the questionnaire was first piloted with six of my MEd colleagues in order to confirm whether the questions were ambiguous or not. The data obtained using questionnaires was triangulated with data from the semi-structured interviews. The questionnaires were written in English and consisted of Part A and Part B (see Annexure G). Part A is where the biological as well as the academic information of the participants was required and Part B is where participants were expected to answer questions related to their perspectives, experiences and pedagogical insights on the integration of local or indigenous knowledge in science lessons. All the four teachers who participated in this study returned the completed questionnaires.

3.3.2 Semi-structured interviews

Cohen et al. (2018) define semi-structured interviews as a conversation between the researcher and respondent. Thomas (2013) posits that an interview enables the researcher to probe the interviewee. This helps the interviewer to clarify questions or generate more elaborative responses by the interviewee. According to Maree (2014), a semi-structured interview usually requires a participant to answer a set of pre-determined questions and it also allows for probing and clarification of answers from the interviewee. In a semi-structured interview, the interviewer decides on the area of interest and formulates questions. I had the interview schedule prepared beforehand. According to Bertram and Christiansen (2015) an interview schedule is a set of questions in a predetermined order. The interview schedule consisted of about five open-ended questions (see Appendix H). These questions aimed at finding out Grade 4 Natural Sciences and Technology (NSTECH) teachers' experiences, perspectives and pedagogical insights on the integration of indigenous knowledge in sciences lessons. This was done to get an insight into what the participants already knew (prior knowledge) before the actual project started. This was also done to determine how much was needed during the intervention.

Before conducting the interviews, I first made appointments personally with each of the four participants. Each appointment was made with a clear explanation of the purpose of this study, the purpose of the interview and the assurance of their confidentiality and anonymity. Unfortunately, one of the participants turned down the appointment citing a busy schedule at his school. The remaining three participants were asked to set a time, date and place that would be convenient for them. The three participants preferred to be interviewed at their respective schools. They also assisted in ensuring that the interview area was quiet and free from distractions.

Although the interview questions were written in English, participants were allowed to express themselves in either English or IsiXhosa. In some cases, participants opted to switch from English to IsiXhosa. As a result, I was free to follow up on responses to seek for further clarifications (Bertram & Christiansen, 2015). Each interview session was voice recorded with the permission of the interviewees. The interviews were intended to help me to ascertain the participants' perspectives, experiences and pedagogical insights on the integration of local or indigenous knowledge into the topic of the features of the moon. The interview sessions took about 60 minutes for each participant. Lastly, each participant was thanked for participating in the study and was reassured of anonymity and confidentiality.

3.3.3 Workshop discussions

Eun (2008) states that the best way to improve teaching and learning strategies is to engage teachers in training such as workshops that will help them to improve their teaching strategies. In support, Shabani (2016) suggests that teachers should be involved in activities that help them to improve their professional development. In light of this, workshop discussions were used to generate data in this study, and they were also audio-recorded. In total four workshops were conducted and all of them were conducted after school hours.

3.3.3.1 Orientation workshop

The first workshop conducted was an orientation workshop which was conducted at Tech Primary school (pseudonym) which is in the Nciba Circuit. This is the school where one of the participants was teaching. The participants identified the school as it would be the central venue for them. After

obtaining the permission from the Principal, we had our first gathering at this venue at around two o'clock in the afternoon. As I mentioned earlier this was just the orientation workshop which was intended to familiarise participants with one another. Furthermore, this is where participants shared their expectations of the workshop. Only three participants were present, and this workshop took about 30 minutes. During this session I explained the purpose of the study, emphasising that we are all co-participants. After that teachers discussed issues such as suitable times for our meetings and the appropriate venue for the upcoming sessions. The teachers seemed excited to be part of this study.

3.3.3.2 Document Analysis

The second workshop was document analysis in which three participants took part. Although we aimed at starting this session at two o'clock, the session started at half past two because one of the participants was delayed.

Figure 3.2. Participants during document analysis

During this session we discussed the curriculum requirements with regards to integration of indigenous knowledge (IK) in Natural Sciences and Technology lessons. Furthermore, the analysis of the syllabus was based on finding out suggested teaching and learning activities that integrate IK in the topic of the features of the moon, as well as seeing what examples of indigenous

knowledge textbooks, the National Education Collaborative Trust (NECT) lesson plans, and Sasol *Inzalo* workbooks provided to enhance the teaching of the topic on the features of the moon. This is in line with Bertram and Christiansen's (2015) notion that researchers can use various existing documents as their source of data, for example, examination papers, teachers' daily journals, learners' workbooks, school policy documents, curriculum statements, and textbooks. The purpose for analysing each document is further explained in Figure 3.2 adapted from Shinana (2019).

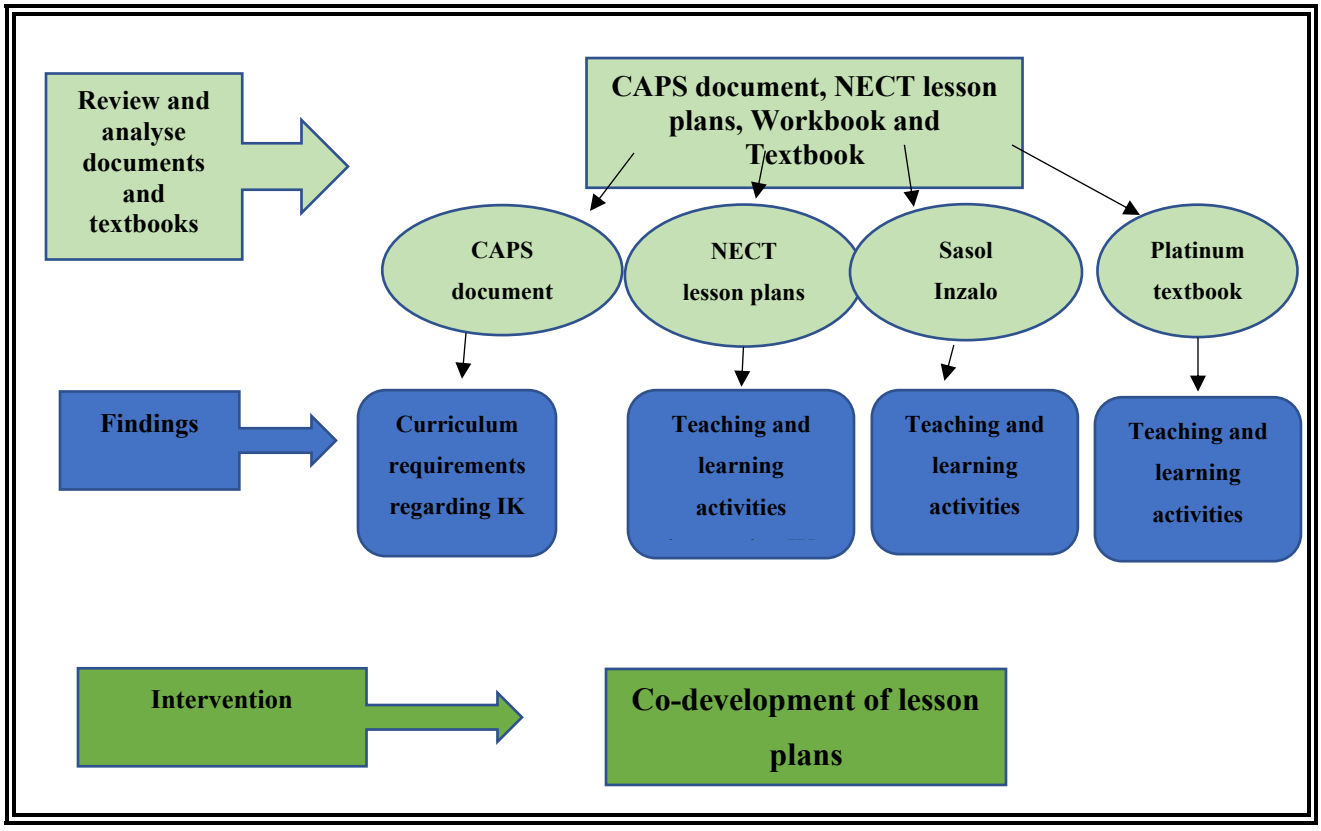


Figure 3.2: Showing the purpose of document analysis (adapted from Shinana, 2019, p. 64)

3.3.3.3 Presentation by the expert community member

The next session we had was the presentation by the expert community member, Chief 'Langaliyakhanya' Mlanjeni. Chief Mlangeni is a Chief of the AmaGcina clan in the Linge area. I was introduced to him by one of my supervisors at work during the advocacy of the mother tongue

based bilingual education (MTBBE) programme. After speaking to him on that day I had a strong feeling that I should use him as a participant in my study because of his passion about IsiXhosa traditions and customs. I then visited him in his homestead and informed him about my study and my intentions to have him as one of the participants. To me, visiting the Chief to request him to be a participant in my study signified the relationship and responsibility of the researcher to respect and honour the relationship with the Elders and the knowledge that they share (Iseke, 2013). The Chief was very excited to be part of this study and to share his information about local or indigenous knowledge, but he requested that our sessions be held late afternoon. Upon the request of the Chief, both sessions that we had with him were held at the Chief's homestead at six o'clock in the evening. Having the evening sessions with the Chief was the most difficult part of the intervention. I had to pick up teachers at their different places and bring them back after the session. The two sessions we had with the Chief ended at around nine o'clock. However, I was motivated by the interest that the teachers showed. One of them said that having these sessions would help them as they were having challenges with the knowledge strand 'Planet Earth and Beyond'. All three teachers who participated in document analysis took part in this phase. We were also joined by the daughter of Chief Mlanjeni, who voluntarily requested to be part of this session, as a video recorder.

Figure 3.3: Chief Mlangeni narrating moon stories

The presentation by Chief Mlangeni, the expert community member, aimed at providing support to the teachers by strengthening their understanding of local or indigenous knowledge about celestial bodies. Teachers then used this knowledge when co-developing model lessons that integrated IK in the topic of the features of the moon.

3.3.3.4 Co-development of model lessons

After the presentation by the community member we gathered at Tech Primary School in order to develop model lessons. We analysed a template of the lesson plan which was developed when I conducted a lesson study for the teachers in my district. We ended up adopting that lesson plan format for this study. The lesson plan was developed based on Specific Aim 2 and 3 as stipulated in the CAPS document of Natural Sciences and Technology. Specific Aim 2 states that learners should have a grasp of scientific, technological and environmental knowledge and be able to apply it in new contexts (South Africa. DoE, 2011)**.** At the same time Specific Aim 3 emphasises that Science and Technology learnt at school should produce learners who understand that school science can be relevant to their lives outside of school. An appreciation of the history of scientific discoveries and technological solutions and their relationship to indigenous knowledge and different world views enriches our understanding of the connections between Science, Technology and Society (South Africa, DoE, 2011). This implies that learners should be aware of the existence of different viewpoints based on scientific beliefs, ethics, values and attitudes in a multicultural society and be open-minded towards all viewpoints. Also, learners should value their cultural heritage (Hanisi, 2007).

The main goal of this workshop was to support teachers to develop science model lessons that integrate IK. This aimed at answering the following research question: *How can Grade 4 Natural Sciences and Technology teachers be supported in planning and developing model lessons on the topic the features of the moon that integrate indigenous knowledge?* All three teachers participated in this phase. In this workshop, the teachers had to decide on the aspects to be included when developing lesson plans. One of the aspects that the participants believed was important in a lesson plan was learner's prior knowledge. This aspect was imperative as the lesson plan in this study was developed to mobilise indigenous ways of knowing. This is in line with doing research with

participants rather than on them, as proposed by Ngcoza and Southwood (2015) and I allowed everybody to voice out every aspect they deemed important when developing a lesson plan. To me, this was necessary so as to create an atmosphere for maximum participation and sense of ownership. The same approach was used by Shinana (2019) in her study on the intervention workshops aimed at supporting teachers to get an understanding of the concept of enzymes and an inquiry-based approach. Also, Merriam (2009) suggests that teachers as adult learners prefer to participate in planning, implementing, and evaluating their own learning. Therefore, allowing participants to fully participate in an activity gives them opportunities to understand the nature of the activity they are involved in (Pollen, 2009). This session took about two hours and two lesson plans were developed.

3.3.4 Journal Reflections

McMillan and Schumacher (2014) explain that journals are a personal account of the learning experienced. In this study, teachers were thus required to keep journals in order to reflect on their personal views of how the research process went, and what experiences they encountered from the intervention. I was first introduced to the idea of writing journal reflections when I was an honours student at Rhodes University.

In my capacity as a Subject Advisor, I subsequently introduced journal writing to teachers involved in this study. That is, after conducting each workshop, teachers were expected to write down some reflections of their experiences of the workshop. In order to save time, teachers were advised to read what they had written in their journals.

Furthermore, at the end of the intervention all three participants were given an opportunity to reflect on their experiences of the whole research process. The participants reflected that before the intervention they did not have sufficient exposure to integration of local or indigenous knowledge into science lessons. Additionally, they reflected on how the whole intervention had positively influenced their views and attitudes towards integration of local knowledge into Natural Sciences lessons.

3.4 Research Process

Basically, Chikamori, Tanimura and Ueno's (2019) Transformative Model of Education for Sustainable Development (TIMESD) framework informed the research process of my study. The TMESD framework was deemed appropriate in this study since it is central to the presentation of local or indigenous practices by the expert community member and co-development of lesson plans, thus improving IK integrated science lessons. To Chikamori et al. (2019), the TMESD framework consists of three learning sub-processes: '*knowing the present*', '*past-present relationships*' (focusing on the dependence of the present on the past) and the '*future-present*' (see Figure 3.2). These scholars refer to the process of studying the past-present relationships as *retroduction* and future-present relationships as *retrodiction*.

In the context of my study, the specific topic was the features of the moon. The first sub-process was achieved through using questionnaires, semi-structured interviews and co-analysing curriculum documents. From this sub-process, I tried to find out teachers' experiences, understandings and their pedagogical insights on integration of local or indigenous knowledge into science lessons and how the topic of the features of the moon is presented in the curriculum documents. For the second sub-process, a presentation on cultural practices relating to the moon was made by an expert community member. This afforded teachers an opportunity to learn about the past, that is, cultural practices that relate to the moon. Notwithstanding, through co-analysing the curriculum documents (the present), we were equipped with lenses to take the present to the past and thereafter to the future. Lastly, the third sub-process was achieved through reflections and co-development of two model lessons that integrated local knowledge on the topic of features of the moon (future). The research process is thus summarised below in Figure 3.4, adapted from Chikamori et al. (2019, p. 9).

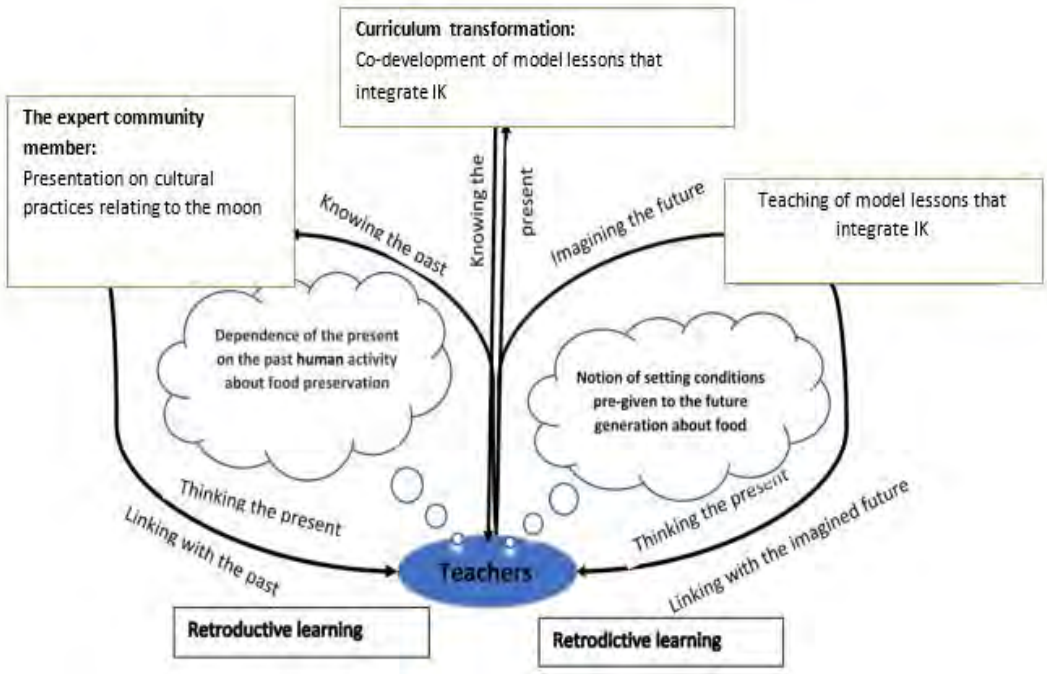


Figure 3.4: Shows the learning process in relation to the features of the moon (adapted from Chikamori et al., 2019, p. 9)

The research process for this study is summarised in Table 3.1 below.

Table 3.1: Shows the summary of the data collection tools

Technique	**Purpose: To find out:**	**Research question**
Questionnaire	Teachers' experiences, perspectives and pedagogical insights on integration of local or indigenous knowledge when teaching the topic of the features of the moon in Grade 4 classes.	1
Semi-structured interviews	Teachers' experiences, perspectives and pedagogical insights on integration of local or indigenous knowledge when teaching the topic of the features of the moon in Grade 4 classes.	1
Workshop discussions	Document analysis - What lessons can Grade 4 Natural Sciences and Technology teachers learn (or not) through co-analysing curriculum documents? - How teachers interacted, participated and learned during the process of document analysis. Presentation by expert community member	2 3

	- What learning opportunities are created (or not) during the presentations by an expert community member on indigenous practices in relation to the moon. - How teachers interacted, participated and learned during the presentation made by the expert community member. - Co-development of model lessons - How can Grade 4 Natural Sciences and Technology teachers be supported in planning and developing model lessons on the features of the moon that integrate local or indigenous knowledge? - How teachers interacted, participated and learned during the process of co-development of model lessons	4
Journal reflections	Allow teachers to express themselves and how they think about the presentations.	4

The above phases are summarised in the following flow chart:

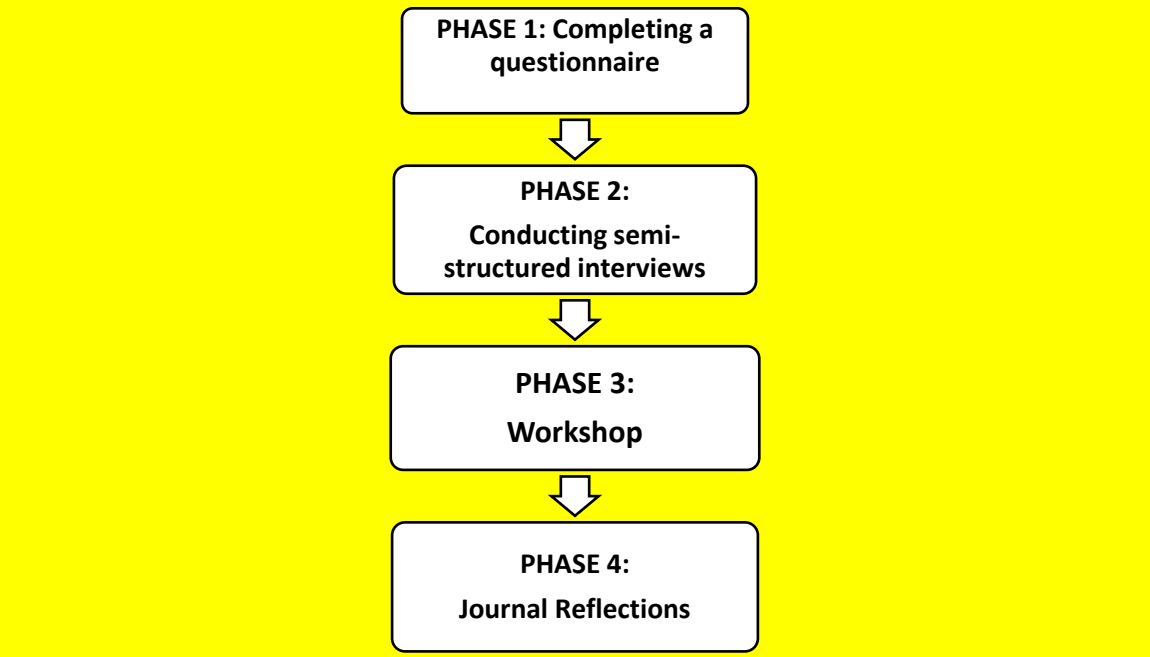


Figure 3.5: Flow chart showing different phases of the data gathering process

3.5 Data Analysis

Data analysis means working from specific observations (data collected) to generalisations, by identifying the themes or categories that emerge from data collected (McMillan & Schumacher, 2014). Bertram and Christiansen (2015) on the other hand, describe data analysis as a process of bringing order and reducing a large amount of data to make sense of it. Concurring, Cohen et al. (2018) explain that data analysis involves organising, accounting for and explaining the data. Data gathered in this study was mainly qualitative and was analysed inductively. The coding technique was applied to all data generated via questionnaires, semi-structured interviews, workshop discussions, and journal reflections.

As advised by Sedlacek and Sedova (2017), some episodes reflecting social interactions and participation that took place during the presentation from the expert community member and co-development of lesson plans, were identified from the video transcripts. Thereafter, data were labelled with codes from which themes and patterns were formulated. This data was analysed focusing on three concepts embedded in Vygotsky's (1978) socio-cultural theory. Those concepts are: social interactions, mediation of learning and zone of proximal development. This assisted in finding out the learning and development that took place as a result of the intervention.

Also, Mavhunga and Rollnick's (2013) and Mavhunga et al.'s (2016) topic specific pedagogical knowledge (TSPCK) components were used to analyse the teachers' learning in social interactions, based on the five components of TSPCK as discussed earlier.

3.5 Validity and Trustworthiness

The use of multiple methods of data generation techniques strengthens the validity of the data (Maree, 2011). As explained earlier on, in my case I will make use of questionnaires, semi-structured interviews, a workshop to develop lesson plans and journal reflections to generate data. This aims at reducing the chances of bias. The questionnaires and interview schedule were piloted with six of my colleagues in the MEd group, to determine if they would be accessible to the participants and to ensure that the questions were unambiguous.

Additionally, the interviews were audio recorded and later transcribed verbatim, so that data would not be lost. Interview transcripts were given back to the participants to check and comment on whether they thought it was an accurate reflection of what they had said. This is called member checking (Cohen et al., 2011). Working together on examining the data or perhaps challenging the data can be useful. As this study was conducted within a community of practice that consisted of myself (researcher) and four teachers, this would assist if one person misses some aspects of the data, as another member could pick that up.

Cohen et al. (2018) claim that using audio recording devices to record verbal interviews is more accurate when compared to taking notes.

3.6 Ethical Considerations

In this section, I highlight how the research supported the ethical principles underlying this study.

Research ethics refers to all values that ought to inform the work of a researcher (Coe, Waring, Hedges, & Arthur, 2017). These scholars further state, that these values can be epistemic (as this research aimed at producing knowledge, thus the researcher should be committed to the honesty of what was discovered and disseminate the knowledge), and practical – the goal of the research should serve the public or improve education. The following are particular considerations that I took into account when dealing with the ethics underlying the study.

3.6.1 Negotiating access and getting informed consent

The participants in this study were four Natural Sciences and Technology teachers in the Komani CMC district. From the four, only three participated during interviews, document analysis, the presentation by an expert community member and journal reflections. These are teachers that I have developed good working relations with, since I undertook my new role as a Subject Advisor. Firstly, I informed them of my intentions to have them as co-participants in my study. I engaged with them in discussions about my study, where I explained the nature and the purpose of the study, as well as the benefits which they would obtain from participating. I then wrote a letter to the District Director, as well as the Principals of the teacher's schools who were partaking in the study, requesting permission to conduct the research with the four teachers in the district. In the

letter, I clearly stated the exact purpose and nature of the research study. After being granted the permission to conduct the study, I compiled and handed consent forms to the participants. Contents of the consent form were read to the participants and any explanations needing to be done, were done at this point. Among those explained, was the assurance that participation was voluntary and participants had the freedom to withdraw from the study at any time.

Concerning the expert community member (Chief Mlangeni), I have known him ever since I assumed my duties as a Subject Advisor. As a member of the school governing body (SGB) forum in the district, he often attends the district stakeholders' meetings, of which as a departmental official I often attend. What fascinated me was his passion for education, as well as his knowledge of the Xhosa culture and local knowledge in general. In one of the meetings, the District Director requested him to open in prayer, and he stood up and sang *ingoma ka Ntsikane ka Gabha*, which he sang alone from beginning to end. It was after this meeting, that I went to him and showed my appreciation in that he still upholds the Xhosa heritage. I then informed him about my study and that I wanted him to be a participant in my study. The Chief was more than willing to participate in the study, and requested that his identity should not be hidden.

3.6.2 Respect and dignity

Firstly, I made a thorough explanation of the study, its aims and how it would benefit the participants. During signing of the informed consent letters, I explained to the participants that their participation in the study was voluntary and thus they had the right to withdraw from the study any time they wished to do so. However, I motivated the participants to participate in the study, hence I tried by all means to ensure good communication practices and to establish trust, so that participants would be at ease when working with me. I was also mindful of and respected the schedule of the participants, hence I ensured that we conducted all the activities in convenient places and times. When the Chief requested that we meet with him at 18:00, I approached them earlier and informed them about this meeting which was going to take place in the late afternoon.

The identities of the participants were treated with a high degree of anonymity and confidentiality, hence, codes were used instead of their real names. I also told them not to write their names on the questionnaire. Lastly, I obtained consent from participants to audio record the semi-structured

interviews and also to video tape the processes of document analysis, the presentation by the expert community member, and the process of development of model lessons. After the study, I will store these videos safely on an external hard drive for five years.

3.6.3 Transparency and honesty

As stated earlier, before issuing consent forms, I first provided explanations of the purpose, nature and the detailed process of the research study to the participants. Participants were requested to sign the consent letters, indicating that they understood and agreed with the terms and conditions of the research. Permission letters and consent forms form part of the research appendices. The processes of document analysis and the development of model lessons were open to suggestions and was amended by the participants without being dominated by me (Bowen, 2009; MacDonald, 2012).

3.6.4 Accountability and responsibility

The study was conducted in accordance with the principles of the ethical policy and guidelines for educational research. On top of that, I will be responsible for safe keeping of all the data collected. All research data (questionnaire responses, interview notes, video and audio tapes), and equipment will be stored on an external hard drive and be kept safely in a lockable cupboard. I was also in constant communication with my supervisor for his guidance.

3.6.5 Integrity and academic professionalism

To ensure integrity and academic professionalism, an accurate account of the data generated by the instruments used was ensured. The data captured were given to the participants to verify that what had been captured was correct. Lastly, this study was conducted in such way that it was free from or explicitly disclosed any political, racial, religious or other bias (David & Resnik, 2015).

3.7 Chapter Summary

This chapter presented the research orientation and approach of the study. The research goal, objectives and research questions, research site, sampling, research procedures and data collection plan were also discussed. It further presented data collection analysis, validation and

trustworthiness of the research. It also discussed issues pertaining to ethical considerations and positionality. The next chapter presents the qualitative data from the orientation workshop discussions and semi-structured interviews.

CHAPTER FOUR: DATA PRESENTATION, ANALYSIS AND DISCUSSION (PHASE 1)

4.1 Introduction

The main goal of my study was to explore an intervention on development of model lessons on the features of the moon that integrate local or indigenous knowledge in Grade 4 classes. In the methodology chapter, I discussed the research design and methodology I used in this study and described how data were gathered to answer the research goal and research questions. In this chapter, I thus present a summary of the qualitative data from the questionnaires and semi-structured interviews. This aimed at answering my research question 1 which was:

> *What are Grade 4 Natural Sciences teachers' experiences, perspectives and pedagogical insights on integration of local or indigenous knowledge in science lessons?*

For Phase 1, my research participants were four Grade 4 Natural Sciences and Technology (NSTECH) teachers from four selected schools nearby. Two of them were new teachers with two years of teaching experience, and two were experienced teachers both in the education field. I begin with the profiles of these four participants. This is followed by the presentation, analysis and discussions that are linked to both literature and the theoretical framework. The chapter concludes with a chapter summary.

4.2 Teachers' Profiles

As I mentioned earlier, for this study I worked with four teachers who answered the questionnaires. These teachers were teaching at four different schools in the Komani Circuit Management centre. The profile of these teachers is presented in Table 4.1 on the following page. Although these

teachers gave themselves pseudonyms, I preferred to give them codes to protect their identity and also to make things easier during the discussions. The codes used were T1 to T4 which represented teacher 1 to 4. Then F and M at the end of the code represents their gender, that is F (female) and M (male).

Table 4.1: Teachers' profiles

Biographical information	Category	Teachers' code	No. of teachers
Age	26-30	T1F	1
	31-35	T2F	1
	36-40	T3M, T4F	2
Gender	Male	T3M	1
	Female	T1F, T2F, T4F,	3
Ethnicity	Xhosa	T1F, T2F, T3M, T4F	4
	BEd	T1F, T2F, T3M, T4F	4
	Rural	T1F, T2F	2
	Semi-urban	T3M, T4F	2
Teaching experience in Natural Sciences	1-5 years	T1F, T2F	2
	6-10 years	T4F	1
	More than 10 years	T3M	1
Religion	Christian	T1F, T2F, T3M, T4F	4

As shown in Table 4.1, one participant was in the age range of 26 to 30 years, the other participant was in the age range of 30 to 35 years old and the remaining were between the ages of 36 to 40. This suggested that all four teachers involved in this study were relatively young. With regards to gender, three participants were females and only one was male. In terms of their qualifications, they all held a Bachelor of Education degree.

With regard to the location of schools where they taught, the male and one female teacher taught at semi-urban schools, whereas the other two females taught in rural schools. Of the four teachers, two females had less than five years teaching experience, one female had 10 years teaching experience and the male teacher had been in the field for 15 years.

4.3 Qualitative Results from Questionnaires and Semi-structured Interviews

Qualitative data were generated from four teachers who answered questionnaires and the three teachers who participated in the interviews. Teacher questionnaires were coded as follows: T1QF meaning, teacher 1, questionnaire, female and T3QM meaning, teacher 3, questionnaire, male. On the other hand, the semi-structured interviews were coded as follows: T2SSF for teacher 2, semi-structured interview, female and so on.

All the qualitative data from the questionnaires and interviews were colour coded and collated based on similarity of responses (see Appendix I). Themes, sub-themes and relevant literature emerged as shown in the table below.

Table 4.2: Shows the themes and sub-themes that emerged from the questionnaire and semi-structured interviews

Research Question 1: What are Grade 4 Natural Sciences teachers' experiences, perspectives and pedagogical insights on the integration of indigenous knowledge in science lessons?		
Themes	**Sub-themes**	**Literature/theory**
Teachers' understanding of local knowledge	- Local knowledge is related to those things that we were told by elders - No clear origin of local and no clear explanation - Some local knowledge are facts and some are not - Examples of local knowledge: - During storm - When there is lightning	Kibirige & Van Rooyen (2006) Semali & Kincheloe's (1999)
Teachers' perspectives on integration of local knowledge into teaching of science	- It would improve content knowledge and grasping of new knowledge - Indigenous knowledge should be included during science lessons - It will make things easier for learners to understand science concepts - It could improve class participation - It creates enthusiasm and critical thinking and creativity - It improves teaching and learning - Learners will learn with understanding rather than just cramming - Learning will be meaningful and practical	Kuhlane (2011) Mavuru & Ramnarain (2017); Vygotsky (1978) Sedlacek & Sedova (2017)

Teachers' experience in integrating local knowledge to science lessons	- Learners find it difficult to understand science, however with some local knowledge it helps to draw their attention - Participation in class	Cronje et al. (2015); Ogunniyi (2007)
Link between science and local knowledge	- Making examples of what they experience every day in their lives makes it easy for learners to understand the concepts - Science is involved in learners' daily lives - Moving from known to the unknown - They relate the information with what is happening in their home	Mukwambo et al. (2014) Kibirige & Van Rooyen (2006)
Benefits of local knowledge	- It would improve content knowledge and grasping of new knowledge - Science is much more advanced and it more likely to be based on experiments so today the children would like to experiment things	Kibirige & van Rooyen (2006) Mavuru & Ramanarain (2017)
Perceived challenges in integration of local knowledge into science lessons	- Local knowledge does not come out with facts - No proof - Local knowledge comes with misconceptions - Less local knowledge documented - Some local knowledge are myths	Ogunniyi (2007) Nyika (2017) Mukwambo et al. (2014); Horsthemke & Schafer (2007); Webb (2013); Nikodemus (2017); Hashondili (2019); Simasiku & Ngcoza (2019)

As shown in Table 4.2, the themes that emerged were: Teachers' understanding of local knowledge; teachers' perspectives on integration of local knowledge into teaching of science; teachers' experience in integrating local knowledge into science lessons; link between science and local knowledge; benefits of local knowledge and perceived challenges of integration of local knowledge into science lessons. Each theme is now discussed.

4.3.1 Teachers' understanding of local or indigenous knowledge

One of the challenges that teachers face with regards to integration of local or indigenous knowledge into science lessons, could be attributed in part to their own understanding of local knowledge or indigenous knowledge. Hence, in both the questionnaires and semi-structured interviews, teachers who participated in this study were requested to state their understanding of local knowledge. Teachers understood indigenous knowledge as:

> *It is indigenous knowledge acquired by people in a certain community, tribe and religion.* (T3QM)

> *The things that elders used to tell us whilst growing up about the way things are done without really knowing their origin.* (T3SSF)

Both definitions of IK showed that these teachers have some understanding of what indigenous knowledge is. Firstly, that it is unique to a certain community or tribe and secondly, that it is orally passed on by elders to their children or grandchildren. This resonates with Kibirige and Van Rooyen (2006), who accentuate that IK is orally passed on from one generation to the other, thus involving the interaction of people from that particular community and that it is also acquired through experience, as well as the relationship with the environment. Moreover, T3SSF noted that since IK is passed from generation to generation it is difficult to track its origin (Kibirige & Van Rooyen, 2006).. It is a different and unique knowledge from society to society.

In expanding their understanding of IK, they provided examples of cultural practices in their communities. T3 for instance said:

> *"An example Meneer, when a dark storm is coming when we grew up we would go out to beat tins and zincs and shout Eeembo! Eeembo! You would see the storm disappear and the sky would be visible again"* (T3SSF).

This comment showed that T3 has some background exposure to cultural practices. It is these kinds of cultural practices that this study sought to use and integrate in the teaching of school science. Furthermore, the example provided by this teacher corroborates with Semali and Kincheloe's (1999) assertion, that indigenous knowledge (IK) involves dynamic native ways of knowing which

involve the creativity of residents of a particular locality, to understand themselves in relation to their natural environment, to seek solutions to their daily problems.

4.3.2 Teachers' perspectives on integration of local knowledge into teaching of science

The data gathered from questionnaires and semi-structured interviews revealed that some teachers have positive attitude towards integration of local knowledge into teaching of science. For example T1 and T2 stated that:

> *Local knowledge could influence science lessons in positive ways because learners will participate in class and help them understand science differently. (T1SSF)*

> *I would like indigenous knowledge to be included during class sessions. I am saying this because maybe it may make science lessons easier and learners could be able to participate in class and some learners would be able to understand. (T2SSF)*

The above views indicate that to have a broader understanding of science concepts and also to improve classroom participation (Vygotsky, 1978; Sedlacek & Sedova, 2017) during science lessons, the use of local knowledge would be of significance. In addition to improved classroom participation, when IK is integrated into science lessons, prior knowledge is important when teaching science, as highlighted by T4: *"It is important to integrate the local knowledge because you will be taking the learners from what they know"* (T4SSF)

Prior knowledge as espoused by Kuhlane (2011), is knowledge that learners possess from their immediate environments, peers, parents and previous lessons. When teachers take learners' prior knowledge into consideration, they are acknowledging the socio-cultural background of these learners (Vygotsky, 1978; Mavuru & Ramnarain, 2017). The above excerpts showed that T1, T2 and T4 believe that learners could enjoy science lessons and actively participate in class when local knowledge is used as prior knowledge during science lessons. This is also proposed by Sedlacek and Sedova (2017), in that prior knowledge arouses the interest of learners since a familiar topic is introduced. It helps learners to become involved in the discussions during social interactions and be more participative (Vygotsky, 1978; Sedlacek & Sedova, 2017).

However, T4 also revealed a significant challenge that comes with integration of IK into science lessons. In the data from the questionnaire he mentioned that: *"Local knowledge does not come out with facts"* (T4SSF).

This is also the warning that scholars such as Hortshemke and Schafer (2007) bring, when they assert that not all IK is relevant to science. In other words, not all everyday contexts provide the information needed for school knowledge, as some may be misleading or cause confusion (Taylor, 1999). Hence, context should be chosen with care in providing that bridge between everyday knowledge and school knowledge.

4.3.3 Teachers' experiences in integrating local knowledge to science lessons

The data obtained from questionnaires and semi structured interviews revealed that these teachers seem to have no experiences in teaching sciences by integrating local knowledge. In the questionnaires, when teachers were asked to state their experience in integrating local knowledge into science lessons both at school and at tertiary levels, T1 and T2 stated that they do not have any experience. T4 provided a *no response* answer. However, T3 showed evidence of the little experience that he has, from when he was taught at school. He stated that: *"When fermentation was explained at school, my teacher would make relevant examples with what we know already. Like making of Mqombothi*" (T3QM).

Having teachers who are not exposed to local knowledge might be a hindrance in integration of local knowledge into science lessons. This is also affirmed by Cronje et al. (2015) and Ogunniyi (2007), as they point out that teachers who are trained in western ways of knowing, may experience some problems in integrating IK in their teaching.

4.3.4 Link between science and local knowledge

The data gathered from the questionnaires and semi structured interviews showed that teachers understand that there is border crossing between local knowledge and western science.

> *When there is lightning we cover mirrors to protect ourselves from being struck by lightning. That knowledge has a link to science.* (T1SSF).

In my area, we had a man whom when we asked him the time, he would check it in the sun, he would look at where the sun was, what it said, and he would tell you the exact time or the time would be a certain time. (T2SSF).

Also, T2 understands how important this kind of knowledge is in learning of science concepts. She commented that: *"Making examples of what they (learners) experience everyday in their lives makes it easy for learners to understand science concepts"* (T2QF).

T3 pointed out that, *"learners are not blank slates they come to school having something they know. They relate the information with what is happen in their homes. ... Learners learn by doing, moving from known to the unknown"* (T3SSF).

These findings affirm the claims by Mukwambo et al. (2014), that even though IK is shunned in some contexts, Western Science however, is extracted and still extracts and appropriates some ideas from IK from all areas of the world. Also, Kibirige and Van Rooyen (2006) emphasise, that IK is a legacy of knowledge and skills unique to a particular indigenous culture and involves wisdom that has been developed and passed on over generations by the use of a trial and error approach.

4.3.5 Benefits and perceived challenges in integration of IK into science lessons

Teachers who participated in this study demonstrated understanding of the benefits and hindrances of integrating IK in the teaching of science.

Among the benefits pointed out by the teachers, is that when IK is integrated into science lessons, it helps learners have a better understanding of scientific concepts:

I think making examples of what they experiences everyday in their lives which is easy for them to understand the concepts. (T3QM)

It would improve content mastery. (T4QM)

T2 and T3 thought that integration of local knowledge would make science lessons interesting and promote learner participation during science lessons.

I think local knowledge would help because it could make learners to understand science and would make them more interested. (T2SSF)

> *Local knowledge could influence science lessons in a positive ways because learners will participate in class and help them understand science differently. (T3SSF)*

The above excerpts are in line with findings of Kibirige and van Rooyen (2006), who acknowledge that when IK is integrated in teaching science it enhances participation, because learners can experience or feel the connection between what they are learning and what they do at home. T2SSF also believed that *"Learners are not blank slates they have something they know. They relate the information with what is happening in their homes"*. This teacher acknowledged the relationship between local knowledge and the science learners learn at school. Scholars such as Mavuru and Ramanarain (2017), discovered that learners are required to use their cultural background knowledge when constructing their science knowledge. Furthermore, Ogunniyi (2007) indicates that learners are loaded with science from their home backgrounds. In this regard, Nyika (2017) stresses that what learners learn from their homes or from their culture, can be used in the classroom as the foundation for learning new concepts.

As mentioned earlier, teachers who participated in this study did acknowledge challenges that come with integration of local knowledge into science lessons. Among issues they raised include:

> *Local knowledge does not come out with facts.* (T4SSF)

> *The challenges could be that some of the local knowledge is not really true and that could affect the true facts of science lessons that are taught in class.* (T1QF)

> *There is less local knowledge documented and the older generation is slowly getting depleted.* (T4QF)

> *There's scarcity of reference material to back your statements.* (T4SSF)

Challenges in integrating local knowledge into science lessons that are similar to these, were also revealed by Mukwambo et al. (2014). In their study, they argued that these challenges are as a result of IK being implicit in nature and usually accompanied by some 'myths' that are not scientific. It is for this reason that scholars argue and advocate for the proper use of IK in science classrooms. Horsthemke and Schafer (2007) and Webb (2013), warn against the assumption that anything using the label 'indigenous' should automatically be accepted and embraced as science. Nikodemus (2017) also believes that not all cultural beliefs and practices are scientific. Kibirige

and Van Rooyen (2006) suggest, that learners should be allowed to debate such cultural beliefs to minimise misconceptions and confusions in the classroom.

In the above excerpts, T4 indicated that: *"There's scarcity of reference material to back your statements"* (T4SSF). Hence in this study, we co-developed model lessons, aiming to bridge that gap, albeit on a small scale. Also, Hashondili (2019) in her study conducted in Namibia, noted that lack of terminologies in indigenous language might hinder the normal teaching of science concepts. Simasiku and Ngcoza (2019) on the other hand, argue that there are more terminologies in indigenous language that could make it very complex to teach science using indigenous language.

4.4 Chapter Summary

In this chapter, I presented qualitative data from the questionnaires and semi-structured interviews. This was aimed at answering the first question of this study. The findings revealed that the teachers involved in this study seemed to understand what local or indigenous knowledge is. Firstly, that it is unique to a certain community or tribe and secondly, that it is orally passed on by elders to their children or grandchildren. The data also revealed that these teachers had no school nor tertiary experience of being taught science that integrated local or indigenous knowledge. Hence, before the intervention they demonstrated lack of understanding of integrating local or indigenous knowledge in their teaching.

In the next chapter, I present, analyse and discuss data generated from document analysis and the presentation by an expert community member.

CHAPTER FIVE: DATA PRESENTATION, ANALYSIS AND DISCUSSION (PHASES 2 & 3)

5.1 Introduction

In the previous chapter, I presented qualitative data from both the questionnaires and semi-structured interviews. In this chapter, I thus present, analyse and discuss a summary of data generated from document analysis (Phase 2), as well as the presentation by an expert community member (Phase 3). The data gathered in these phases aimed at answering the following research questions:

- What lessons can Grade 4 Natural Sciences and Technology teachers learn (or not) through co-analysing curriculum documents?
- What learning opportunities are created (or not) during the presentations by an expert community member on indigenous practices in relation to the moon, sun and stars?

5.2 Document Analysis

This phase aimed at answering research question 2:

> What lessons can Grade 4 Natural Sciences and Technology teachers learn (or not) through co-analysing curriculum documents?

Document analysis took place after the first session which was an orientation session. The orientation workshop was the first gathering for all the participants and it was intended to familiarise participants with one another. Furthermore, this is where participants shared their expectations of the workshop. Only three teachers (T1F, T2F and T3F) of the four participating teachers, took part in document analysis. Document analysis took place at Tech Primary School (pseudonym) and took about 1 hour 30 minutes. This session aimed at determining the curriculum

requirements with regards to integration of indigenous knowledge (IK) in Natural Sciences and Technology lessons. Furthermore, the analysis of the syllabus was based on finding out suggested teaching and learning activities that integrate IK in the topic of the features of the moon. Also, what examples of indigenous knowledge do textbooks, the National Education Collaborative Trust (NECT) lesson plans, as well as Sasol *Inzalo* workbooks provide, to enhance teaching of the topic on the features of the moon. This is in line with Bertram and Christiansen's (2015) notion that researchers can use various existing documents as their source of data, for example, examination papers, teachers' daily journals, learners' workbooks, school policy documents, curriculum statements, and textbooks.

5.2.1 Curriculum and Assessment Policy Statement document

The first document we co-analysed during this phase was the Natural Sciences and Technology Curriculum and Assessment Policy Statement (CAPS) (South Africa. DoE, 2011) document. As mentioned earlier, the purpose of analysing the CAPS document was to find out what the curriculum requires regarding the integration of IK in the teaching of science in South African classrooms. I requested each teacher to take out the CAPS document and go through section 1. While we were still reading through contents of section 1, one of the teachers (T3) referred us to a section on page 4. She said:

> *Guys ndiqaphela something pha kwii* (Guys I'm noticing something here) ... *general aims of South African curriculum, where it is mentioned that one of the aims is: Valuing indigenous knowledge systems: acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution.*

Another teacher (T1) remarked that: *"Yho hay sana mna andizijongi nokuzijonga ke ezi izinto"* (I don't even look at these things). From both of these statements I found out that teachers were learning what the South African curriculum requires of them. In the context of this study, I call that subject matter knowledge (SMK) and curriculum knowledge (CK). However, Shulman (1986) states that subject matter knowledge precedes PCK.

At the same time, T3 referred us to three other sections where indigenous knowledge is mentioned on page 8, where it states that:

> One of the differences between modern Science and Technology and traditional, indigenous knowledge systems is that they have their origins in different world views. As with all knowledge, scientific knowledge changes over time as scientists acquire new information and people change their ways of viewing the world.

She said: *"Ndirhalela khe siyifunde sonke"* (Let us all read it) and continued by reading the following (p. 8):

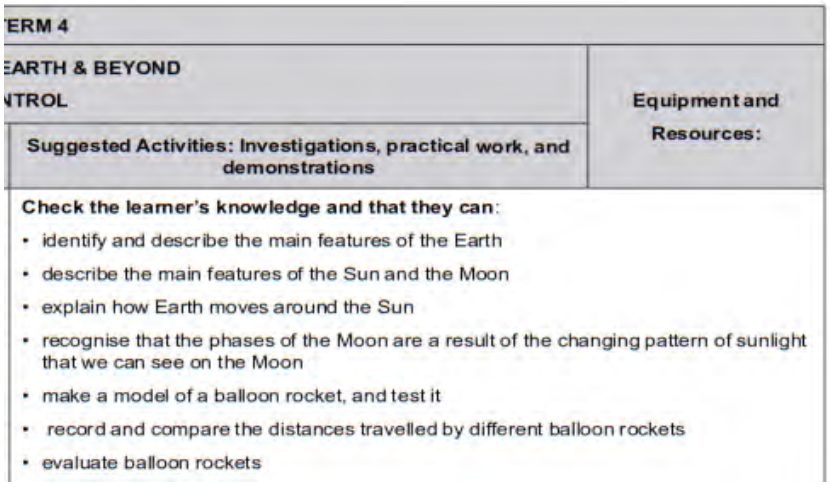
> Careful selection of content, and use of a variety of ways of teaching and learning Science and Technology, should promote understanding of:
>
> - Science and Technology as activities that sustain enjoyment and curiosity about the world and natural phenomena
> - The history of Science and the relationship between Natural Sciences and Technology and other subjects. Learners should understand the different cultural contexts in which indigenous knowledge systems were developed.

T3 continued to say: "*Bendifuna nje sibone ukuba* (I just wanted us to see if) *according to CAPS, lento ye IK is coming in strongly"*. These excerpts revealed that the teachers were now realising that integration of IK in science is mandatory, as it is stipulated in the guiding principles of CAPS.

Through document analysis, we found out that in the knowledge strand 'The Planet Earth and Beyond', the only topic where local or indigenous knowledge is stated, is features of the moon. The following excerpt is the only area where IK or cultural knowledge is mentioned:

> **Moon stories**: Cultural stories about the moon tell us about the importance of the moon in people's lives. (p. 30).

As we continued analysing the CAPS document, we noticed that there are no suggested teaching and learning activities provided by the CAPS document as shown in Figure 5.1 below.



ERM 4	
EARTH & BEYOND NTROL	Equipment and Resources:
Suggested Activities: Investigations, practical work, and demonstrations	
Check the learner's knowledge and that they can: • identify and describe the main features of the Earth • describe the main features of the Sun and the Moon • explain how Earth moves around the Sun • recognise that the phases of the Moon are a result of the changing pattern of sunlight that we can see on the Moon • make a model of a balloon rocket, and test it • record and compare the distances travelled by different balloon rockets • evaluate balloon rockets	

Figure 5.1: Showing extract from CAPS document on suggested teaching and learning activities (South Africa. DoE, 2011, p. 30)

This is one of the shortcomings of IK as stated by Nyika (2017), that most teachers do not use IK in the classroom as it is not assessed in the examinations. Teachers tend to focus on the work that will be assessed in the examination. According to Nyika (2017), teachers tend to see IK as a waste of time, as teachers need to finish the syllabus on time and prepare the learners for examinations.

Through analysing the CAPS document, the participants learnt that the Natural Sciences and Technology curriculum does call on teachers to integrate indigenous knowledge, however, it does not provide methods on how to integrate local knowledge in the teaching of science lessons. We then moved on and analysed other learning and teaching materials.

5.2.2 Learners' textbooks, Sasol *Inzalo* learners' book and NECT lesson plans

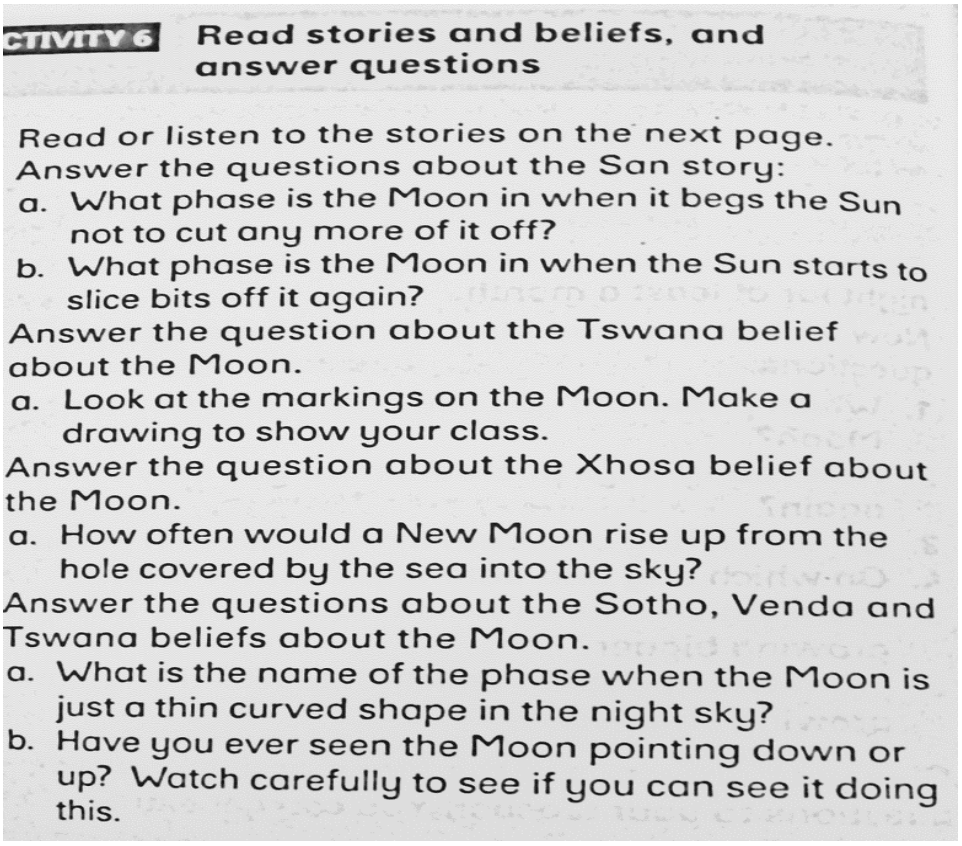
The document analysis was further done using the resource material shown in Table 5.1 on the next page.

Table 5.1: Showing analysis of curriculum documents

RESOURCE MATERIAL	HOW IK IS INTEGRATED IN THE TOPIC OF FEATURES OF THE MOON
1. Text books	
- Spot On Natural Sciences and Technology	- Features of the Moon - Phases of the Moon - Moon Stories (no stories)
- Platinum Natural Sciences	• Features of the Moon • Phases of the Moon • Moon Stories - Why the Moon changes its shape – San story - The markings on the Moon – Tswana story - How we get a new Moon – Xhosa story - Meaning of the direction of the pointed ends of the Moon – Sotho, Venda and Tswana stories
2. NECT Lesson Plans	• Features of the Moon • Phases of the Moon • Moon Stories - A story from the San people - A story of the Sotho, Venda and Tswana people - A story from Europe - A story from Inuit people of Greenland - A story of the Algonquian tribes of Native Americans
3. Sasol *Inzalo* Workbook	• Features of the Moon • Phases of the Moon • Moon Stories - The story of the Moon and the hare - The story of the Moon and the Sun

Regarding the above documents, the aim was to find out how the topic of the features of the moon is presented. Furthermore, to find out if the curriculum document had guidelines on planning and teaching of the topic of features of the moon so that we could have a clear understanding on how to integrate local or indigenous knowledge when teaching this topic.

What we observed was that the teaching and learning approach adopted by Platinum Natural Sciences, is that the teacher reads the short stories from different tribes and cultures. Learners are expected to listen and respond to questions, as shown in the extract below.



CTIVITY 6 **Read stories and beliefs, and answer questions**

Read or listen to the stories on the next page.
Answer the questions about the San story:

a. What phase is the Moon in when it begs the Sun not to cut any more of it off?
b. What phase is the Moon in when the Sun starts to slice bits off it again?

Answer the question about the Tswana belief about the Moon.

a. Look at the markings on the Moon. Make a drawing to show your class.

Answer the question about the Xhosa belief about the Moon.

a. How often would a New Moon rise up from the hole covered by the sea into the sky?

Answer the questions about the Sotho, Venda and Tswana beliefs about the Moon.

a. What is the name of the phase when the Moon is just a thin curved shape in the night sky?
b. Have you ever seen the Moon pointing down or up? Watch carefully to see if you can see it doing this.

Figure 5.2: The extract taken from Sasol Inzalo Teachers' guide (p. 143)

NECT adopts a similar approach, in the sense that the teacher is instructed to write the notes on the chalkboard as shown in Table 5.2 below.

Table 5.2: Showing the teaching approach adopted by NECT lesson plans

THE MOON IN STORIES *TOPIC: The Moon* *The stories people told about the moon tried to explain what the moon was and why it looked the way it did.* *Think about:* *1. Who are the main people in each story?* *2. How important was the Moon in the story?* *3. What part did the Moon have?*

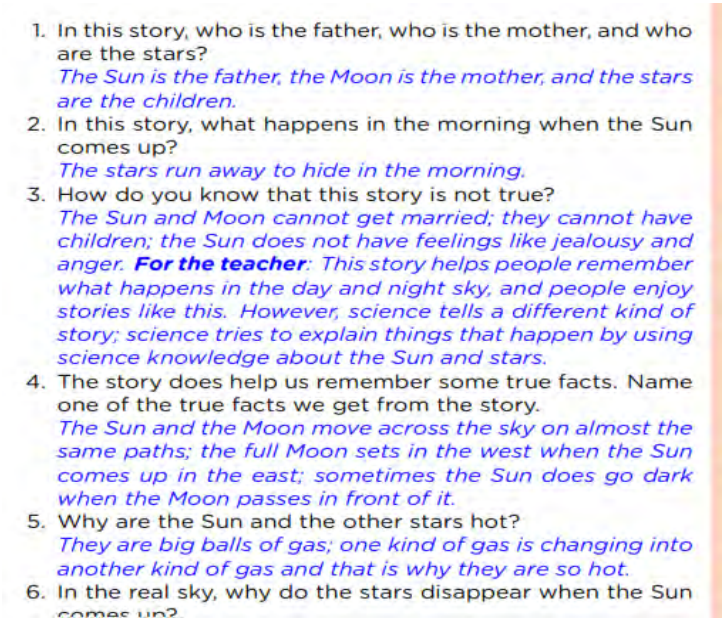
The teacher then is instructed to read a few *stories* to the learners, as shown in the above table. Learners listen carefully so that they can answer the questions. A similar approach is adopted by the Sasol Inzalo workbook, however, in this workbook, teachers are encouraged to allow learners to read the stories themselves and underline new words.

QUESTIONS

1. What do you think the people who told this story were looking at on the Moon when they described the 'mud' on the Moon's face?
   They might have been describing craters which appear darker.
2. Do you think it was right that the hare threw mud at the Moon?
3. What emotion was the hare experiencing?
   jealousy

Figure 5.3: Showing the teaching approach adopted by Sasol Inzalo workbook

As we did document analysis, we observed that in all three textbooks, the stories told can be regarded as 'myths'. However, we found out that in those myths there is science embedded. In line with our assertion, Masoga (2004) states that IK is stored in cultures in various forms, such as traditions, customs, folk stories, folk songs, folk dramas and myths. Also, teachers appreciated the fact that learners are afforded opportunities to state whether the story is a myth or not, as shown in Figure 5.4 below:



1. In this story, who is the father, who is the mother, and who are the stars?
   The Sun is the father, the Moon is the mother, and the stars are the children.
2. In this story, what happens in the morning when the Sun comes up?
   The stars run away to hide in the morning.
3. How do you know that this story is not true?
   The Sun and Moon cannot get married; they cannot have children; the Sun does not have feelings like jealousy and anger. ***For the teacher****: This story helps people remember what happens in the day and night sky, and people enjoy stories like this. However, science tells a different kind of story; science tries to explain things that happen by using science knowledge about the Sun and stars.*
4. The story does help us remember some true facts. Name one of the true facts we get from the story.
   The Sun and the Moon move across the sky on almost the same paths; the full Moon sets in the west when the Sun comes up in the east; sometimes the Sun does go dark when the Moon passes in front of it.
5. Why are the Sun and the other stars hot?
   They are big balls of gas; one kind of gas is changing into another kind of gas and that is why they are so hot.
6. In the real sky, why do the stars disappear when the Sun comes up?

Figure 5.4: Showing types of questions asked in the Sasol Inzalo workbook

This is what Kibirige and van Rooyen (2006) suggest, that when the beliefs and cultural practices contain non-scientific elements, learners should be allowed to debate such cultural beliefs to minimise misconceptions and confusions in the classroom. This might help learners see how WS is embedded in their cultural practices and how WS and IK contain features that are similar. Thus, IK and WS should not be seen as competing with one another, but rather they should be seen as complementing one another (Ngcoza, 2017). For instance, in the story narrated in Sasol *Inzalo*, learners are asked to explain what people are talking about when they say there is mud on the moon's face. Hence, the expected answer is that they are referring to craters. It is in circumstances like these, as Mandikonza (2007) stresses, that indigenous knowledge may be used to explain how things are done and be complemented by WS.

We also observed from the document analysis that the teaching approaches used in the above mentioned textbooks do not take learners' prior knowledge into account. Le Grange (2007) warns that teachers should not ignore learners' prior knowledge, as their learning is embedded in their socio-cultural environment (Mavuru & Ramnarain, 2017), which plays a major role in learning of science in the classroom. As an alternative to the approaches used by the textbooks, T3 suggested that we request learners to come up with moon stories from home.

In this situation, IK can be used as the prior knowledge of learners to enrich the teaching of science (Kibirige & Van Rooyen, 2006). Allowing learners the opportunity to narrate moon stories from their everyday lives might increase learner participation during this lesson, as each learner might want their story to be heard. The use of IK in the classroom may increase learners' participation during science lessons (Erinosho, 2013; Sedlacek & Sedova, 2017). Sedlacek and Sedova (2017) posit, that the participation of the learners in the lesson determines the quality of the teaching and learning process. Hence, the participation of learners in the lesson can be enhanced, once they see the connection between everyday activities and what is learned in the classroom.

This suggests, that the inclusion of IK in the lessons may serve as the starting point in teaching science concepts (Simasiku et al., 2017). For this reason, Shava (2000) suggests that educational pedagogics should be contextualised, so that it encourages the learners to share their experiences.

5.3 Presentation by the Community Member

As part of the intervention, I requested an expert community member by the name of Chief Langaliyakhanya Mlanjeni to share his cultural ideas on celestial bodies, especially the moon.

Research reveals that when community members take part in education matters, cultural identity is strengthened (O'Donoghue et al., 2007; Cocks et al., 2012). Furthermore, Mandikonza (2007) states that community members have knowledge of cultural practices and that these practices can be used in teaching science. Hence, we decided to have an expert community member to share his knowledge about the cultural practices that could be useful in teaching the topic of features of the moon.

All three teachers (T1, T2 and T3) who participated in document analysis, also took part in this phase. We were also joined by the daughter of Chief Mlanjeni, who voluntarily requested to be part of this session, as a video recorder. The presentation by Chief Mlangeni, the expert community member, aimed at providing support to the teachers by strengthening their understanding of local or indigenous knowledge about celestial bodies. Teachers then used this knowledge when co-developing model lessons that integrated IK in the topic of the features of the moon.

5.3.1 Summary of presentation by the expert community member

From the presentation of the expert community member I developed the following episodes (see Appendix G). From these episodes, I developed themes and then related themes to the literature. Episodes, themes and relevant literature are shown in the table below.

Table 5.3: Episodes, themes and relevant literature

EPISODES	THEME	LITERATURE
Welcoming and cultural etiquettes	Socio-cultural issues	
Presentation techniques Knowledge, skills, attitudes and values	Mediation of learning	
Improved understanding of local knowledge	Zone of Proximal Development	

5.3.1.1 Socio-cultural issues

Chief Mlanjeni who is the Chief of the Ilinge area, also prefers to be called *Tyhopho*, his clan name or just Chief. It was his request that his real name be used in this study, not a pseudonym. I first spoke to him over the phone, requesting him to take part in my study. I also explained to him the goals of my study. Among the things he said in his response, was:

> *Hlathi ndifuna ukuba yinxalenye yesistudy sakho. Ndifuna abantu abafunda esisistudy bazi ukuba kusekho iziswenye ezinobutyebi ngentlalo yakwaNtu. Xa uyokuthweswa ndizakuhamba nawe. Futhi undikhankanye* (I would like to be part of your study. I want

people who read this study to know that there are still people who have rich knowledge about cultural issues).

The interest of the Chief to be part of my study, taught us the importance of involving community members, who according to Mukwambo (2016) are custodians of cultural knowledge.

The 67 year old chief who is also a traditional healer holds a Form 1 (Std. 6/Grade 8) in terms of an educational qualification. He is a proud isiXhosa speaker. We had one session with him which lasted about three hours. As per his request, we attended this session at his homestead. This session was held in the afternoon as he said he does not want to give us divided attention. He explained:

> *Yizani emalanga Hlathi. Andifuni ukuba ndithi ndihoye nina ndibe ndiphazanyiswa zezinye izinto. Yizani emalanga Hlathi sixovule lomba ubaluleke kangaka* (Please come in the afternoon, I don't want to give you divided attention. Come in the afternoon so that we discuss this very important matter).

To me, the above statement showed how enthusiastic this community member was in sharing his cultural knowledge with us. Truly, I was humbled by this gesture. When I told the participating teachers that we had an appointment with the Chief at 18:00, they showed their excitement and at 17:30 they were already waiting for me as they did not want to run late. However, their excitement was short-lived because of some cultural etiquettes.

For instance, all three participating teachers were dressed in long pants and as a result they were reprimanded by the Chief's headman for that. We were also admonished for entering into the main house and asking for the Chief without being told to sit down first. Teachers were standing next to me on the right-hand side of the house, and were told to shift and sit on the bench which was the left side of the house, *emva kocango* (behind the door), where females sit. I could see disappointment and confusion on my teachers' faces, however, after sitting down I sincerely apologised, stating that we did not know the protocols of visiting a *komkhulu (*great place). But all this did not deter us from our mission. We were finally guided into the house, where the Chief was eagerly waiting for us. The Chief was very excited that we came. He then introduced us to the headman, his son, his daughter and his wife (*MaMcethe* – wife's clan name). He stated:

> *UHlathi nababafundisi ntsapho balapha ukuze sipheke lembiza. Ndifuna ke xa ivuthiwe ndingashiywa ngaphandle. Ndimxelele ukuba igama lam libeyinxalenye yestudy sakhe. Abagqibelisanga ke ukuza apha, rhoqo befika ndifuna bazi ukuba iingcango zivuliwe* (Hlathi and the teachers are here so that we prepare this pot. When this is finished don't forget to mention me. I told him that I want my name to be part of his study. This is not their last time coming here, whenever they come here they should know that the doors are open).

5.3.1.2 Mediation of learning

After all the other people had left, the Chief greeted us once more and welcomed us and thanked the teachers for sacrificing their time to come and listen to him. Although his daughter was video recording the proceedings, I was amazed when he requested each one of us to have a pen and paper to note the important things. Fortunately, we all had brought our pens and notepads. He then requested each one of us to introduce ourselves and he emphasised that he wanted to know our clan names. Teachers introduced themselves by their names and schools where they teach. He requested again that they tell him their clan names. To me, this was the same approach Prof Ngcoza uses in our community of practice. Teachers were amazed at the manner in which he knew their clan names. He then requested us to tell him why we were there and what expectations we had from him. He then said: *"Bafundisi ntsapho nikho ngabuni apha. Yintoni enifun'ukuyiva?"* (Teachers, tell me why are you here and what actually do you want to learn?).

There was absolute silence, seemingly, no teacher wanted to talk first. I stepped in and stated the reasons why we were there:

> *Silapha ukuzokufumana ulwazi gabalala ngolwazi lwemveli, ulwazi nenkcubeko yethu nangendlela esiphila ngayo nekwakuphilwa ngayo kudala. Injongo yethu kukwazi ukuba ololwazi singalusebenzisa njani ukuphuhlisa ukufundwa nokufundiswa kwe sayensi. Eyona nto siyifuna ngamandla kukubaluleka kweLanga, iNyanga neeNkwenkwezi kwinkcubeko yethu* (We are here to get broad understanding about indigenous knowledge, knowledge about our culture, the ways of living and how people used to live. We want to find ways of integrating this knowledge in teaching of sciences. Specifically, we would like to know the cultural importance of the Sun, the Moon and the Stars).

In his presentation, the Chief told us about the importance of names in the Xhosa culture, stating that naming in the Xhosa culture is something that is taken very seriously as it is used to convey

certain messages, either to an individual, family or to the community. He made an example of the name he was given by his father, *Xakabantu*. He believes that this name gave other people the impression that he is a troublemaker. This is similar to Madiba's indigenous name, *Rolihlahla* which also means 'troublemaker'. In contrast, however, he explained that he is a person who liked to debate things when he was still very young, and most people marvelled at that. He believes that that has earned him much respect in the community, as he is a person who reveals 'truths' that surprise most people, even the intellectuals. He added that his chieftainship name is *Langaliyakhanya* (Sunlight). He elaborated further:

> *Lento ibonisa ukuba kufuneka ndikhanyisele izizwe. Ngoba iLanga likhanyisela aboni namalungisa ingajonganga nzuzo. Yiyo lonto nam ndinceda wonke umntu ndingajomganga mbuyekezo* (This shows that I have to give light to the nations. The Sun gives light to saints and sinners without expecting any reward).

He then moved on to talk about different indigenous plants and animals. He touched on a wide range of plants and their therapeutic value. These included *imithuma*, *umsobo* (watercress), and *umnquma* (wild olive). I was thinking about how to interject the Chief to prevent him from going too far, when he started talking about the importance of the sun in the Xhosa culture. Stating that although the sun is used as the source of light and warmth, it is very important in time keeping, as it is the main indicator of the day and the seasons. He explained:

> *Xa iLanga lilapha phezu kwethu, yhazi kusemini emaqanda. Ngeloxesha isithunzi sakho silingana nawe* (At noon the Sun is right above us. Your shade will be in line with your body).

He also spoke about the moon:

> *Uyabona ke sikhula silunyukiswa ngoomakhulu noomama ngomama owayeyokuchola ngeCawa waza wabethwa lizulu wayokuthi nca eNyangeni. Lento ibisenza soyike ukusebenza ngeCawa ngoba nyhani siyambona lomama ubeleke usana uthwele nenyanda* (When we grew up we were told by our parents and grandparents about a woman who went to fetch wood. She was struck by lightning and she was attracted to the moon. This made us to be scared to work on Sundays).

The Chief also told us the following *stories*:

> *Xa iceba leNyanga lijonge ezantsi lonto ichaza ilishwa nokufa, Kanti ukuba lijonge phezulu lonto ichaza indyebo. Xa ilele ngecala iza nomoya. Kanti xa iphelele iligqange elibomvu ngomhla weKrismesi lonto ichaza ukuba kuzakubakho imbalela kunyaka olandelayo* (When the moon crescent is facing down,that symbolises bad luck. If the crescent is facing upward that symbolises a season of abundance. If the crescent is facing sideways, there is going to be wind. If there has been a red full moon during Christmas there is going to be drought the following year).

The Chief also touched on the stars. What fascinated the teachers were the names of the stars – the bright stars of the night sky, *Ikhwezi lokusa* and *Celizapholo.* The Chief explained:

> *Niyazazi izapholo? Hee..?* (laughing). *Ucelizapholo yinkwenkwezi ivela ngela xesha lokusenga ngokuhlwa. Xa amakhwenkwe esanya izapholo. Yiyo lonto kusithwa ngucel'izapholo* (Do you know milk? Venus is a star that shines during the time of milking of cows. At that time boys are milking. That is why we call it asking for milk).

Teachers seemed to be confused by these names. I chipped in and said: *"Ikhwezi lokusa no Celizapholo yila planet kuthwe nguVenus" (*Morning star and Evening star are that planet called Venus). Teachers started to smile and T3 exclaimed: *"Ooh, Ok"*. After this the Chief said: *"Jambase mandime apha namhlanje khe ndiniyeke niyokwetyisa. Andifuni kuningxixha"* (let me stop there for today so that you go and internalise. I don't want to overload you).

This to me showed a person who was time conscious, who knew that the concentration span of learners was limited.

5.3.1.3 Improved understanding of local knowledge

Firstly, the presentation by the Chief was done in the medium of isiXhosa. As the Chief presented in isiXhosa, teachers got the opportunity to think deeper and connect the presentation to their daily teaching practices, especially in the knowledge strand 'The Planet Earth and Beyond', as well as other science topics in general. Mavuru and Ramnarain (2019), as well as Masimanga and Lelliot (2014), state that using home language for engagement facilitates conceptual understanding of science concepts.

From the Chief's presentation, teachers also identified other possible topics where local or IK could be integrated. For example, the Chief spoke a lot about indigenous plants and animals,

emphasising their cultural significance. This related to the topic of biodiversity which is taught in Grade 5 and 7, as well as conservation of the environment which is taught in Grade 5. This is an indication of learning that took place during the expert community member's presentation.

On our way back home, I listened to teachers reflecting on what took place during the presentation. For instance, T2 commented about the Chief's emphasis on each person having a pen and a paper. She said: *"Hayi sana uzenza iititshala"* (he behaves like a teacher). Notably, the Chief wanted the teachers to have his undivided attention and not to miss out on very important aspects of his presentation. The Chief as a more knowledgeable other (Vygotsky, 1978), in this case was showing them the seriousness of this presentation. This talks to the pedagogical aspect. Another aspect that is related to pedagogy that emerged during the presentation by the Chief, is that he wanted to involve the teachers during his presentation – as according to Sedlacek and Sedova (2017), active participation enhances learning. When he asked them to tell him what *izapholo* is, unfortunately, there was no teacher who attempted to respond.

Throughout his presentation, I observed curiosity and eagerness on the side of the participating teachers. As the Chief presented, teachers were taking notes and nodding occasionally. The whole process led the teachers to believe that local or indigenous knowledge is a powerful tool for learning and teaching. T3 wrote in her reflections: *"I personally knew nothing about the relationship between iKhwezi and the planets. It's for the first time to know that uCelizapholo is Venus"* (T3R).

The planet Venus is one of the planets in our solar system and the topic of the 'Solar System' is taught in Grade 4. This means that the presentation provided an opportunity for teachers to think and relate these presentations to their teaching practices. I remembered that all these teachers wrote in the questionnaire that they do not integrate IK in their lessons because they do not have enough knowledge on IK. The above comment showed that there had been a shift in teachers' learning.

As the Chief presented, teachers were able to relate the knowledge the Chief presented to the knowledge they gained during document analysis. T2 wrote in his reflections: "*The Chief*

mentioned the story of a woman who is carrying a baby which was also mentioned in the textbooks and also in the NECT materials" (T2R).

Additionally, teachers were able to come up with scientific concepts that emerged from the expert community member's presentation. Also, our encounter with the expert community member did not only teach us knowledge in a contextualised environment, but strongly addressed the issues of attitudes and values.

Although this session was well carried out, there were a few challenges. One of those challenges concerned the issue of time. As we started in the late afternoon, the presentation dragged until very late, at 21:00 to be precise. The presentation by the Chief took quite long, yet we did not feel it because it was interesting and educational. Teachers also commented that the Chief spent a long time on indigenous plants and animals. I believe that this is his favourite topic, as he is also a traditional healer. Amidst all of these constraints, the Chief showed us his willingness to support and share his in-depth local knowledge, not only on what we asked him to present, but also the knowledge that he thought we needed to know.

5.4 Chapter Summary

Through analysing the CAPS document, the participants learnt that the Natural Sciences and Technology curriculum does call on teachers to integrate indigenous knowledge, however it does not provide methods on how to integrate local knowledge in the teaching of science lessons. We also found out that all the other three learning and teaching materials adopted the same approach. That is, the teacher reads the short stories from different tribes and cultures and learners are expected to listen and respond to pre-determined questions. Moreover, teachers learnt from each other and shared information on what the curriculum and the subject policy expected from them.

In the next chapter, I analyse and discuss the summary of data gathered from co-development of the model lessons.

CHAPTER SIX: DATA PRESENTATION, ANALYSIS AND DISCUSSION (PHASE 4)

6.1 Introduction

In the previous chapter, I presented, analysed and discussed qualitative data from the document analysis discussions, as well the data that emerged from the presentation by the expert community member. In this chapter, I thus present, analyse and discuss qualitative data generated from co-development of model lessons that integrated local or indigenous knowledge (IK) in the topic of the features of the moon. The main goal of this workshop was to support teachers to develop science model lessons that integrate IK. This aimed at answering the following research question:

> *How can Grade 4 Natural Sciences and Technology teachers be supported in planning and developing model lessons on the phases of the moon that integrate indigenous knowledge?*

6.2 Summary of Findings on Planning and Co-development of Model Lessons

Three themes in Table 6.1 were used to present, analyse and discuss the findings that emerged during the workshop on co-development of lesson plans.

Table 6.1: Showing episodes, themes and relevant literature that emerged during development of model lessons

EPISODE	THEME	LITERATURE
- Teachers' ideas on components of the lesson plan	- Importance of prior knowledge	Shinana (2019); Merriam (2009); Pollen (2009)
- Curriculum requirements on integration of IK into science lessons	- Social interactions	South Africa. DoE (2011); Ngcoza & Southwood (2015).
- Teaching and learning activities	- Mediation of learning	Vygotsky (1978); Cobern & Loving (2001); Hodson (2009); Horsthemke & Schafer (2007); Webb (2013); Shulman (1986)
- Reflections on the process of development of model lessons	- Reflections	

I now discuss each theme.

6.2.1 Components of the lesson plan

This session began with a discussion on what aspects had to be included when developing a lesson plan. In line with doing research with participants rather than on them as proposed by Ngcoza and Southwood (2015), I allowed everybody to voice out every aspect they deemed important when developing a lesson plan. To me this was necessary, so as to create an atmosphere for maximum participation and sense of ownership. The same approach was used by Shinana (2019) in her study, in the intervention workshops aimed at supporting teachers to get an understanding of the concept of enzymes and an inquiry-based approach. Also, Merriam (2009) suggests that teachers as adult learners prefer to participate in planning, implementing, and evaluating their own learning. Therefore, allowing participants to fully participate in an activity gives them an opportunity to understand the nature of the activity they are involved in (Pollen, 2009). The excerpt in Table 6.1 shows some of the suggested aspects that were to be included in our model lessons.

Table 6.2: Showing workshop discussions

T3: I think firstly we should have general aspects such as grade, topic, duration of the lesson and resources as part of our lesson plan
T2: Also learning objectives
T3: Yes, I agree…can't we also include Specific Aims and Process Skills?
Me: No guys, let's just throw these aspects then we will see what to include and in which order.
T3: Assessment also…
T1: Teacher and learner activities
T3: I think we should also include key concepts

The above excerpt shows that teachers had some ideas on some of the aspects that should be included in the lesson plan. This according to Shulman (1986) is called curriculum knowledge.

The next step was to develop the template for the lesson plan. T3 suggested that we use the same template we used when we conducted a lesson study the previous year. This is the provincial template that we developed as Subject Advisors, however, it still needed some modifications here and there. We agreed that this was an ideal template, as it contains all the aspects we would like to include in our lesson plan. These aspects cover Mavhunga and Rollnick's (2013) TSPCK components. We also put in all the general aspects such as grade, date, knowledge strand, topic and sub topic.

6.2.2 Curriculum requirements on integration of IK into science lessons

We then moved on to find out which specific aims and process skills would be suitable for the lesson we were developing. In our attempt to find which specific aims, process skills and content to include, we went back to the Natural Sciences and Technology CAPS document. This is the document through which the Department of Basic Education articulates its position regarding IK and school science from 2011 going forward. We observed that indigenous knowledge systems

(IKS) are included under Specific Aim 3 of the Natural Sciences and Technology CAPS document; *'Science, Technology and Society'*. The sub aims under this Specific Aim are:

- Learners should understand the practical uses of natural sciences and technology in society and the environment and have values that make them caring and creative citizens;
- Science and Technology learnt at school should produce learners who understand that school science can be relevant to their lives outside of school; and
- An appreciation of the history of scientific discoveries and technological solutions, and their relationship to indigenous knowledge and different world views, enriches our understanding of the connections between Science, Technology and Society.

However, there was a strong feeling from some of the teachers that IKS should not be limited only to Specific Aim 3. For instance, T3 indicated that IK can be integrated in any Specific Aim. She said: *"I think IK can be integrated in Specific Aim 1 and 2 as well. Teaching and learning activities of our lesson will determine the Specific Aims as well as process skills we are addressing".*

Concurring, T1 added that: *"Your choice of Specific Aim will depend on the teaching and learning activities learners engaged in*. *Unyaninisile maan* (that's true), *it's our activities that will tell which specific aims are we addressing*".

We thus felt that we should proceed to teaching and learning activities. Hence, our next discussion was on what to include under teaching and learning activities. This revealed a shift in teachers' curriculum knowledge and subject matter knowledge (Shulman, 1987). Also, this kind of discussion is a reflection that through professional development or professional learning communities, teachers can learn from each other (Ngcoza & Southwood, 2019).

6.2.3 Teaching and learning activities

Our next discussion was on what to include under teaching and learning activities. T3 posed a question: *"What aspects of indigenous knowledge are we going to include in our lessons? Because most stories that we came across in the textbooks are folk stories".* In her question, it seemed T3 was aligning herself with the warning posed by scholars such as Cobern and Loving (2001),

Hodson (2009), Horsthemke and Schafer (2007) and Webb (2013) that not everything labelled indigenous should automatically be assumed and embraced as science. However, Kibirige and Van Rooyen (2006) suggest, that when beliefs and cultural practices contain non-scientific elements, learners should be allowed to debate such cultural beliefs to minimise misconceptions and confusions in the classroom. Furthermore, IK is stored in culture in various forms, such as traditions, customs, folk stories, folk songs, folk dramas and myths (Masoga, 2004). Hence, T1 and T2 felt that for the first lesson it would be ideal to allow learners to come up with moon stories, moon songs or any traditions about the moon from their homes and narrate them in class. After each story, the teacher should open time for oral discussions to determine which aspects were scientific and which ones were myths. Teachers believed that learners should not only say this aspect is a 'myth', but should provide scientific explanations. After learner discussions, the teacher should then hand out the worksheet to be completed by learners.

T3 felt that affording opportunity to a community member to come and present cultural stories about the moon would be ideal. After that, the teacher would then allow learners the opportunity to ask questions. T3 further reflected: "*What I like is that the community member will present ngesiXhosa. Learners will partake because they will be asking questions in isiXhosa".* The teacher confirmed Vygotsky's (1978) idea that language is indeed a mediatory tool used to enhance learning. She further said: *"You have seen from the Chief that the elders are willing to share the knowledge and skills that they hold with the children in school".* The willingness of the school and community to share knowledge is a significant finding not only in this study, but in other South African studies, such as in Hewson, Javu and Holman (2009), Aikenhead (2001), Malcolm, Sutherland and Keane (2008) and Klein (2011). These studies emphasise the involvement of elders (as community knowledge bearers) in developing a framework for 'long-term science education'.

Notwithstanding, T3's suggestion was that learners should research moon folk stories, moon folk songs, legends and 'myths' about the moon that are retold in their communities. Similar to the above studies, this would encourage learners to learn from their parents, grandparents and other adults in their community. In this manner, indigenous people would also get an opportunity to participate in curriculum development (Masoga, 2004). The use of folk stories, folk songs and so forth, is what Mavhunga and Rollnick (2013) refer to as representations. According to Mavhunga

and Rollnick (2013), this refers to how learning content should be presented in such a way that it carries meaning to the learners. These representations could be illustrations, metaphors, demonstrations, experiments, analogies, models or stimulations (Mavhunga & Rollnick, 2013; Mavhunga et al., 2016).

For the second lesson we agreed that the teachers should print out as many stories that relate to the phases of the moon as possible, and allow learners to paste them on their workbooks. Also they should find some of the cultural beliefs about phases of the moon from textbooks and from the internet. Thereafter, the teachers should explain to the learners that there are many different cultures in the world and that they all might have different stories for the same thing. That is, there are many ways to look at something. People can learn about other cultures by listening to their stories. The learners should then read these stories, and some might be similar to the stories they narrated the previous day. The teachers will then provide learners with a set of questions that they should answer. Using stories from different cultures might help remove the misunderstanding that IK only belongs to Africans, and this might strengthen the pedagogical relevance of the inclusion of IK (Khuphe, 2016).

Furthermore, Shava, O'Donoghue and Ngcoza (2015) suggest using a number of strategies for the teaching and learning of indigenous knowledge. The methods take into account that IK is about holistic, context-based, integrated people environment interrelationships and can, therefore, best be acquired in practice-oriented activities. They suggest the use of the following strategies:

- Observations: Many indigenous practices are embedded in everyday practices and can be learned through observation or, through participating in these activities, namely, experiential learning/learning by doing.
- Investigations: About indigenous practices with the learners' communities.
- Deliberations: Classroom discussions on (particular aspects of) IK can reveal the wealth of IK and be a process of "learning from each other" (p. 27).
- Storytelling: As a traditional way of passing on IK can also be practised in the classroom.

These teaching methods are similar to the methods that teachers suggested and included in their lesson plans. Thus, during this lesson planning, teachers' Topic Specific Pedagogical Content Knowledge (TSPCK) was analysed, adopting Mavhunga and Rollnick's (2013) content specific components namely: students' prior knowledge, curricular saliency, what is difficult to teach, representations including analogies and conceptual teaching strategies. The following is a brief description of how each component was applied during the lessons.

(e) Learners' Prior Knowledge

According to Mavhunga et al. (2016), this component involves elicitation of learners' prior knowledge and paying attention to their misconceptions. Mavhunga et al. (2016) further states that this component also requires the teacher to have the skill of being able to handle the preconceptions or misconceptions learners might have. It also includes understanding of knowledge that learners might have as a result of prior teaching, before teaching the new concepts. This was also confirmed by the study by Kuhlane (2011), that revealed that the use of prior knowledge and experiences during teaching and learning facilitate meaningful learning. Hence, teachers who participated in this study felt that learners' prior knowledge should be the starting point in our teaching and learning activities. During workshop discussions the teachers perceived prior knowledge as the learners' moon stories, moon songs and any cultural stories. After each story, the teacher should open time for oral discussions to determine which aspects are scientific and which ones are myths. The oral discussions would be the right platform to confront misconceptions.

(f) Curricular saliency

This component refers to the identification of the most important meaning of major concepts of a topic, without which, understanding of the topic would be difficult for learners. It also includes the knowledge to logically sequence the learning and knowledge of pre-concepts needed prior to teaching a topic (Mavhunga et al., 2016). Similarly, Shinana (2019) emphasises that this component demands that the teacher identifies the major concepts around the topic (the big ideas), and the prerequisite concepts learners need to know before the topic is presented. Within this

component, the participating teachers started by discussing the curriculum requirements. Hence the following suggestions from some of the teachers came up:

> *I think IK can be integrated in Specific Aim 1 and 2 as well. Teaching and learning activities of our lesson will determine the Specific Aims as well as process skills we are addressing.* (T3)

> *Your choice of Specific Aim will depend on the teaching and learning activities learners engaged in. Unyaninisile maan* (that's true), *it's our activities that will tell which specific aims are we addressing.* (T1)

After reaching the specific aims to be covered, the teachers suggested the key concepts that learners should understand that could also be a hindrance in understanding of this topic. The participating teachers identified concepts such as, rotation, revolution, craters, crescent, gibbous, waning, waxing, new moon and full moon, as the key concepts that learners should understand.

(g) What is difficult to teach

Mavhunga et al. (2016**)** refer to gatekeeping concepts which are difficult to understand, often because they cause conflict with previously established understanding 'what is difficult to teach'. As suggested by Mavhunga et al. (2016), this component describes teachers' insights into the concepts within a topic that are difficult to teach, for example, the misconceptions which learners have that could possibly hamper their understanding.

As already discussed in Section 2.1, the topic of the moon is one of the important Natural Sciences topics under the knowledge strand 'Planet Earth and Beyond'. It is also known to be a fundamental topic in understanding other sub topics such as the phases of the moon, lunar eclipse, and solar eclipse. Yet, it is poorly performed by learners and poorly taught by teachers.

During workshop discussions, one of the teachers confessed that one of the challenges they face in helping learners understand the concept of the features of the moon, could be attributed to their own understanding of this concept. This challenge is due to misconceptions attached to the concept of the moon. Among the misconceptions raised, some are shown in Table 6.3.

Table 6.3: Showing some of the misconceptions teachers have

The moon phases are due to the Earth shadow
Eclipses of the Moon are a particular case of the phases of the moon
The moon does not rotate
The moon makes its own light instead of reflecting sunlight
The moon takes one day to orbit the sun

With reference to Table 6.1, those concepts are moon or lunar eclipse, rotation of the moon and phases of the moon. The use of moon stories, moon songs and cultural traditions when teaching the concept of features of the moon, might help towards better understanding of the concept.

(h) Representations and conceptual teaching strategies

According to Mavhunga and Rollnick (2013) and Mavhunga et al. (2016), representations refer to how learning content should be presented in such a way it carries meaning to the learners. Shinana (2019) suggests this can be achieved using aids that teachers consider having potential to support the teaching of content. The component of conceptual teaching strategies on the other hand, is referred to as teaching strategies derived from the considerations made from the other four components and excludes general teaching methodologies (Mavhunga et al., 2016). Within these two components, our discussions focused on what teaching and learning activities we could include in our lesson plans in order to enable learners to understand the concept of the features of the moon. During workshop discussions, we observed that in the Natural Sciences and Technology CAPS document there are no suggested teaching and learning activities regarding the topic on features of the moon. The CAPS document only prescribes the content of the 'moon stories', which is just explained as "cultural stories about the moon ... tell us about the importance of the moon in people's lives" (South Africa. DoE, 2011, p. 29). However, the participating teachers had some suggestions regarding how to teach this topic in a way that would be meaningful to learners.

As is explained in Section 6.2.3, T1 and T2 felt that for the first lesson, it would be ideal to allow learners to come up with moon stories, moon songs or any traditions about the moon from their homes and narrate them in class. After each story had been narrated, the teacher should open time for oral discussions to determine which aspects were scientific and which ones were myths. Teachers believed that learners should not only say this aspect is a 'myth', but should provide scientific explanations. After learner discussions, the teacher should then hand out the worksheet to be completed by learners.

Teachers also felt that affording an opportunity to a community member to come and present cultural stories about the moon would be ideal. After that, the teacher would then allow learners the opportunity to ask questions. One of the teachers said; "*What I like is that the community member will present ngesiXhosa. Learners will partake because they will be asking questions in isiXhosa".*

The stories that learners would narrate in class, the songs that they would perform and presentations that would be done by the expert community member, would therefore be used as representations. Furthermore, the use of vernacular language during presentations by both the learners and the expert community member, would increase the rate of participation.

6.2.4 Teachers' reflections

After the development of the model lessons (see Appendix J), the teachers had the opportunity to reflect on the way this process promoted their pedagogical content knowledge. The following are some of their reflections after lesson planning.

Table 6.4: Showing some of teachers' reflections after the workshop

After this session I feel, I have not been doing justice in my teaching. I have not been reading what the CAPS requires. I completely neglected some aspects in the textbooks such as the moon stories because I thought that they were just myths. (T3)
Overall this session went really well. I like the fact that the lessons we planned are learner centred. (T1)
This process gave me more understanding of IK and how it should be integrated into science lessons. (T2)
Honestly, during the first phase of our lesson preparation I felt insecure. I almost lost focus because I thought I don't know how this whole integration of IK to the topic of the moon will entail. (T2)
From this experience I learned that I need to adopt teaching styles that take learners' cultural background into consideration. (T3)
We spent a lot of time on planning stage that we had to run through other activities because of time. I think having another time for an activity like this would result in more learning. (T3)

Looking at the teachers' reflections, it can be deduced that they now feel confident about integration of IK in science lessons. They also reflected about their past experiences in the way they interpreted the CAPS document and the way they taught Natural Sciences, which was not in line with curriculum expectations. In reference to the excerpts above, teachers felt empowered, prepared and ready to implement the curriculum requirements to their fullest. In addition, the acquisition of this subject matter knowledge (SMK) might strengthen their pedagogical content knowledge (PCK) (Shulman, 1987), as well as their understanding of the nature of science. This is similar to Asheela's (2017) study, in which her findings revealed that teachers' dispositions towards practical activities using easily accessible resources had positively shifted, due to the exposure during the intervention.

6.3 Chapter Summary

In this chapter, I presented, analysed and discussed the data gathered from the workshop on co-development of model lessons and teachers' reflections. The findings revealed that the co-development of lesson plans contributed to collaborative learning. After the session, the participating teachers felt empowered in both the subject matter knowledge, as well as pedagogical

content knowledge. In the next section, I present the summary of my findings, recommendations and conclusions.

CHAPTER SEVEN: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

7.1 Introduction

It was observed that that the Department of Education (DoE) does not adequately equip and support teachers with the necessary pedagogical skills to integrate IK into Natural Sciences lessons. Neither does the DoE provide IK exemplars in terms of model lessons that can be used by Natural Sciences teachers. For this reason, this study aimed at exploring an intervention on development of model lessons on the features of the moon that integrated indigenous knowledge in Grade 4 classes. It looked at teachers' experiences, perspectives and pedagogical insights on the integration of indigenous knowledge in science lessons and how Grade 4 teachers could be supported in developing model lessons that integrate local or indigenous knowledge.

This study adopted Vygotsky's (1978) socio-cultural theory and Shulman's (1986) pedagogical content knowledge as the theoretical and analytical framework respectively. The study adopted a qualitative case study approach underpinned by an interpretivist perspective. Data were gathered and triangulated using questionnaires, semi-structured interviews, document analysis, and a presentation by an expert community member, workshop discussions and journal reflections. Qualitative data were inductively analysed, whereby episodes and themes were developed.

In this chapter, I thus present a summary of my findings in relation to my research questions. Moreover, recommendations, limitations, and areas for further research are also presented. Personal reflections on the whole research journey are highlighted and the chapter ends with some concluding remarks.

7.2 Summary of Findings

In this section, I summarise the findings of the study in relation to the research questions that guided this study:

1. What are Grade 4 Natural Sciences and Technology teachers' experiences, perspectives and pedagogical insights on integration of indigenous knowledge in science lessons?

2. What lessons can Grade 4 Natural Sciences and Technology teachers learn (or not) through co-analysing curriculum documents?

3. What learning opportunities are created (or not) during the presentations by an expert community member on indigenous practices in relation to the moon, sun and stars?

4. How can Grade 4 Natural Sciences and Technology teachers be supported in planning and developing model lessons on the features of the moon that integrate indigenous knowledge?

7.2.1 Research question 1

> *What are Grade 4 Natural Sciences teachers' experiences, perspectives and pedagogical insights on integration of indigenous knowledge in science lessons?*

Data gathered from questionnaires and semi-structured interviews showed that the participating teachers have some understanding of indigenous knowledge. For instance, they understood that indigenous knowledge is unique to a certain community or tribe and secondly, that it is orally passed on by elders to their children or grandchildren. This description is similar to Kibirige and Van Rooyen's (2006) definition that IK is orally passed on from one generation to the other, thus involving the interaction of people from that particular community, and is also acquired through experience, as well as the relationship with the environment.

The data also revealed that teachers' understanding of local knowledge is based on cultural practices and the everyday way of life. This was evident from the examples of indigenous practices they provided such as:

> W*hen a dark storm is coming when we grew up we would go out to beat tins and zincs and shout Eeembo! Eeembo! You would see the storm disappear and the sky would be visible again.* (T3QM)

The data generated from the questionnaires and semi-structured interviews also showed that some of the teachers do not have school nor tertiary experience of being taught science through integration of IK. However, one of them stated that he had a glimpse of IK at school level. In the questionnaires, for instance, he wrote that: "*When fermentation was explained at school, my teacher would make relevant examples with what we know already. Like making of Mqombothi*" (T3QM).

It could thus be hypothesised that these teachers have mostly been exposed to WS and have not been exposed to any form of IK training. This might be the reason why all of them confessed that they do not integrate IK when teaching science. This resonates with Ogunniyi's (2007a) notion, that the challenge faced by teachers is that they are expected to implement a radically different instructional approach compared to the so-called 'Western Science' they were taught to use at teacher training colleges.

The last thing that emerged from questionnaires and semi-structured interviews is that local knowledge is not documented. The participating teachers noted that lack of documentation is one of the reasons they do not integrate IK into their lessons. Additionally, resources such as textbooks are a hindrance to successful integration of indigenous knowledge (Shizha, 2007).

7.2.2 Research questions 2 and 3

- *What lessons can Grade 4 Natural Sciences and Technology teachers learn (or not) through co-analysing curriculum documents?*

- *What learning opportunities are created (or not) during the presentations by an expert community member on indigenous practices in relation to the moon, sun and stars?*

The data gathered during document analysis revealed that the teachers seem to be aware of the requirements of the National Curriculum Statement (R-12), in that it calls for Natural Sciences and Technology teachers to integrate IK into their lessons (see Section 5.2). From the analysis of the CAPS document, for instance, the participating teachers noted that moon stories are the only example of IK mentioned in the curriculum. It was also revealed that the CAPS document does not provide any suggested teaching and learning activities. Moreover, IK is not included in any suggested assessment activities as shown in Figure 5.2.

Qualitative results from textbook analysis revealed that the moon stories that the textbooks use are similar. Teaching and learning activities provided in the text books are such that learners read the story, of course, guided by the teacher. Then learners are required to answer a list of pre-determined questions.

Data gathered from the document analysis revealed that there were changes in teachers' perceptions regarding integration of IK into science lessons. Looking at the teachers' reflections, it can be deduced that they now feel confident about integration of IK in science lessons. They also reflected about their past experiences in the way they interpreted the CAPS document and the way they taught Natural Sciences, which was not in line with curriculum expectations. Results revealed that the participating teachers now feel empowered, prepared and ready to implement the curriculum requirements in their fullness.

Research question 4:

> *How can Grade 4 Natural Sciences and Technology teachers be supported in planning and developing model lessons on the features of the moon that integrate local or indigenous knowledge?*

The qualitative results presented in Section 6.2 revealed that most of the participants are familiar with lesson planning. This was evident during the open discussions on the components of the lesson plan. It emerged that there was a change in the participants' understanding of integration of IK into science lessons, as shown by the type of questions they asked during the intervention. The quality of engagement that took place during the intervention, enabled the main themes to emerge

as shown in Table 4.2. Those themes were: teachers' ideas on components of the lesson plan; curriculum requirements on integration of IK into science lessons; teaching and learning activities; and reflections on the process of development of model lessons. The data gathered during this phase revealed that the teachers actively participated during co-development of model lessons (Sedlacek & Sedova, 2017). Furthermore, data revealed that the use of the TSPCK components (Mavhunga & Rollnick, 2013) provided the teachers with the opportunity to gain insights into how they could teach the topic of the moon by integrating IK.

7.3 Recommendations

The present study revealed important findings which, if taken note of, have the potential of improving the implementation of the integration of IK into science lessons by Natural Sciences and Technology teachers in the Chris Hani West district. On the basis of these findings, a number of recommendations can be suggested for teachers, as well as for professional development purposes. The recommendations arising from this study are therefore discussed under these two categories.

7.3.1 Teachers

Natural Sciences and Technology teachers need to be aware of learners' socio-cultural factors which influence science learning (Mavuru & Ramnarain, 2017). That is, the learners' socio-cultural backgrounds which they bring to the classroom should be used as prior knowledge during teaching of Natural Sciences. It is therefore recommended that teachers should be aware that the use of the learners' socio-cultural background during teaching and learning of Natural Sciences learners, affects both how they make sense of scientific concepts and also the extent to which they are willing to participate during teaching and learning processes. Teachers should also encourage parental involvement in educational matters as this might strengthen the community and their cultural identities (O'Donoghue et al., 2007).

7.3.2 Continuing Professional Development

Firstly, teachers who participated in this study lacked exposure to the integration of IK into science lessons during their university or college training. According to Shizha (2007), when many

teachers start teaching science after their studies, they lack an indigenous African perspective because they were not trained to interpret science in a culturally sensitive manner. It is therefore, recommended that universities in South Africa should redesign their courses/modules in the undergraduate, as well as post graduate teaching courses to include IK. Universities should not only equip prospective teachers with IK, but also how to translate this knowledge into effective practice.

Secondly, the in-service teachers need opportunities to be re-trained in approaches to teach IK in their classrooms. Professional development and in-service training should be given for teachers to become actively engaged in meaningful discussion, planning and practice, particularly focusing on how the new curriculum materials and teaching methods will be used in the classroom.

Lastly, there is a need for the teachers to share teaching practices by observing each other's lessons to improve their pedagogical content knowledge (Shulman, 1978). This could be done through Professional Learning Communities (PLCs), How I teach programmes, lesson study programmes and through teacher engagement in communities of practice. In such programmes, teachers would hopefully be encouraged to collaboratively develop lesson plans that integrate local knowledge. These lesson plans would then be implemented in the classroom.

7.4 Limitations of the Study

The present study has some limitations that need to be taken into account when considering the study and its contributions to the field.

7.3.1 Sample size

The first limitation was that only four teachers from four schools in the Komani Circuit Management Centre participated in the study. From these four teachers, only three were available for the semi-structured interviews, document analysis, as well as the intervention in the form of a workshop. That means the sample size of this study was too small for its findings to be generalisable to all teachers of the Chris Hani West district. However, some insights were provided by this study.

7.3.3 Language

The collection of both sets of data had limitations with regards to language issues. Although the participants in this study were teachers, the sample consisted of teachers whose home language was isiXhosa, with English their second or third language. A language barrier may have existed when they were completing the questionnaire. Therefore, these teachers may have expressed themselves more clearly had they expressed their views in the questionnaire in isiXhosa, thus giving greater insights into the results.

7.3.4 Time constraints

The data generation process was conducted after school hours, which also reduced the amount of data that could have emerged with this research project due to time constraints. If I were to do this study again, I would extend the duration of the data collection process. I believe the issue of time also had effects on the quality of teacher participation. This was observed during the presentation by the Chief which took place late, where teachers were reluctant to ask any questions. This might be due to fatigue, as teachers could have come to the workshop tired from their normal teaching day.

7.4 Areas for Further Research

This study has opened opportunities for possible further research which involve a bigger sample in terms of schools and the number of teachers. I would also recommend that a further research on the same topic be conducted and be taken further by exploring how the teachers mediate the co-developed lessons in their Grade 4 classes.

7.5 Reflections

Firstly, I wish to attest to the fact that becoming a Master's student was not an easy journey. I became a Rhodes student in 2011 doing my BEd Science course. I remember those years where I was doing my first year of BEd Science course vividly. My main target was to get my BEd degree and that was all. However, after completing my BEd Science course *cum laude,* Prof Ken and Ms Zukiswa Kuhlane (now Dr Zukiswa Nhase) encouraged me to enrol for BEd (Hons). It was during my Honours programme when I was introduced to the process of research by Prof George Euvard

and Prof Mgqwashu. Mr Kavish Jawahar, Prof Ken and Ms Kuhlane introduced me to the concept of indigenous knowledge in the Science elective course.

Being a part-time Master's student was not an easy thing to do due to other crucial commitments such as work and family. I enrolled for a Masters' degree while I had just been employed as a Subject Advisor in the Komani district. At the same time, my mother passed away and that disturbed me emotionally. This taught me to strike a balance between my studies, my work and my everyday life.

One area that I struggled the most with was deciding on the topic. Initially, I was more interested in any research project that had to do with practical activities. The assistance from my supervisor and classmates helped me to finally decide on my topic and I finally started my proposal. While I was busy with my proposal, my work commitments began to increase. I had to move around the province, attending programmes such as the Subject Advisors' Induction, Subject Advisors' Indaba, and strategic planning, to mention just a few. At the same time, I had to prove the point that my appointment was on merit. Through the support from my supervisor and my classmates, I managed to finish and submit my proposal. This was a huge relief for me, even more so when I received the report that my research proposal had been approved. I was jubilant because I thought that half of my work was done. Little did I know that I had to undergo what I regarded as the most strenuous part of my research process that is, getting the ethical clearance certificate through the newly introduced online system. Again through the support of my classmates who had submitted theirs earlier, I finally got the ethical clearance letter. This experience taught me to be resilient and work hard all the time. Also, this taught me the importance of team work. As Prof called our group a community of practice, we all embraced an African Proverb that says: *"*if *you want to walk fast walk alone, if you want to walk far walk together"*.

The willingness of Natural Sciences and Technology teachers to participate in my study was an eye-opener and a memorable experience for me. This is what is called *Ubuntu* in our culture, meaning 'I am because you are'.

Lastly, this long research journey, where I had to read, write drafts, and then proofread, provided me with all the needed skills, knowledge and experience on academic writing. As a Subject Advisor, I learnt how to work with teachers as a community of practice to improve their pedagogical skills. All in all, I found the research journey rewarding and fruitful!

7.6 Conclusion

The primary aim of my study was to explore an intervention on the development of model lessons on the features of the moon that integrate indigenous knowledge in Grade 4 classes.

The first phase of this study focused on gathering data using questionnaires and semi-structured interviews, aimed at assessing the teachers' perspectives and pedagogical insights on integration of IK into science lessons. Data gathered in this phase revealed that teachers have some understanding of indigenous knowledge, but they lack exposure of how to integrate IK into science lessons, both at school and at tertiary levels. For that reason, all the participating teachers indicated that they do not integrate IK when teaching science.

The study has established that teachers' participation in professional development within an intervention enabled them to learn how they could integrate indigenous knowledge when planning lessons on the features of the moon.

The study thus recommends that Natural Sciences teachers should be aware of learners' socio-cultural factors which influence science learning, and should use this as prior knowledge during teaching and learning. It is recognised, however, that there is a need for more research to be conducted on how the teaching and learning of science could be improved by tapping into local and indigenous knowledge. Finally, this study, albeit on a small scale, has provided some insights on how to go about integrating local or indigenous knowledge in science classrooms.

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Appendices

Appendix A: Ethical Clearance

RHODES UNIVERSITY
Where Leaders Learn

Human Ethics sub-committee
Rhodes University Ethical Standards Committee
PO Box 94, Grahamstown, 6140, South Africa
t: +27 (0) 46 603 8055
f: +27 (0) 46 603 8912
e: ethics-committee@ru.ac.za

www.ru.ac.za/research/research/ethics
NHREC Registration no. REC-241114-045

26 September 2019

Thando Magwentshu

Review Reference: 2019-0334-934

Email: g13M8235@campus.ru.ac.za

Dear Thando Magwentshu

Re: Exploring an intervention on the development and implementation of model lessons on acids and bases that integrate local knowledge in grade 7 in the Queenstown District

Principal Investigator: Prof Kenneth Ngcoza

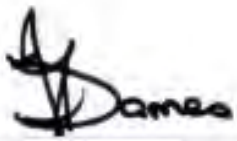
Collaborators: MR THANDO MAGWENTSHU

This letter confirms that the above research proposal has been reviewed and **APPROVED** by the Rhodes University Ethical Standards Committee (RUESC) – Human Ethics (HE) sub-committee.

Approval has been granted for 1 year. An annual progress report will be required in order to renew approval for an additional period. You will receive an email notifying when the annual report is due.

Please ensure that the ethical standards committee is notified should any substantive change(s) be made, for whatever reason, during the research process. This includes changes in investigators. Please also ensure that a brief report is submitted to the ethics committee on completion of the research. The purpose of this report is to indicate whether the research was conducted successfully, if any aspects could not be completed, or if any problems arose that the ethical standards committee should be aware of. If a thesis or dissertation arising from this research is submitted to the library's electronic theses and dissertations (ETD) repository, please notify the committee of the date of submission and/or any reference or cataloging number allocated.

Sincerely



Appendix B: Letter to the District Director

Paragraph Styles

NO 1 PEACOCK STREET
QUEENSTOWN
5320
28 May 2019

THE DISTRICT DIRECTOR
CHRIS HANI DISTRICT

Dear Sir

RE: REQUEST TO CONDUCT INTERVENTION STUDY WITH TEACHERS AT KOMANI CMC

I am a registered Masters in Science Education student at Rhodes University. My area of interest is integration of indigenous knowledge (IK) in Natural Sciences lessons. One of the principles of the National Curriculum Statement (NCS) is integration of indigenous knowledge and different world views in the Science Curriculum. However, teachers are encountering many problems with the integration of IK in the Science Curriculum, of which among them is lack of learning and teaching material that shows how this should be done in the classroom.

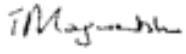
My study therefore aims at supporting teachers on how to integrate indigenous knowledge in Natural Sciences lessons. This will be achieved through:

- Inviting the expert community member to do presentation on cultural views about the moon, stars and the sun
- Analyzing curriculum documents
- Co-developing model lessons that integrate indigenous knowledge in the topic of the features of the moon in grade 4 class.

Additionally, I would like to enable Natural Sciences teachers to develop their own model lessons that integrate indigenous knowledge.
I intend to develop a questionnaire which must be completed by at least 15 teachers including those who will be participating in the study. I will work with four educators who will voluntarily participate in development of model lessons. The time frame for gathering the data will be from May to October 2019.

I therefore request approval from the Department so that I can start contacting the schools and Natural Sciences I'll be working with. Should you have any questions about the research, please feel free to contact me at 078 1522 740 or ingcalicoop@gmail.com or my supervisors Prof Ngcoza (k.ngcoza@ru.ac.za).

Yours Truly



Magwentshu Thando

Appendix C: Consent Form from the Department of Education

Curriculum Head and District Director Consent form

I MRS NOSIPHO HANISI ,the **Chief Education Specialist** of Chris Hani West District have read and understood the conditions under which this research project will be carried out. I understand that participation is voluntary and that the teachers who choose to participate are free to withdraw from the study at any time, and this will not prejudice them in any way.

I therefore AGREE/~~DISAGREE~~ (delete inapplicable) that the study be conducted in the district.

I Nicolaas R.W. de Bruyn ,the **District Director** of Chris Hani West District have read and understood the conditions under which this research project will be carried out. I understand that participation is voluntary and that the teachers who choose to participate are free to withdraw from the study at any time, and this will not prejudice them in any way.

I therefore AGREE/DISGREE (delete inapplicable) that the study be conducted in the district.

SIGNATURES

DESIGNATION	SIGNATURE	DATE
CHIEF EDUCATION SPECIALIST	Hanisi	30.05.2019
DISTRICT DIRECTOR		30.05.2019

Appendix D: Consent forms from the schools

NO 1 PEACOCK STREET
QUEENSTOWN
5320
28 May 2019

THE PRINCIPAL
LONWABO PS

Dear Sir/Madam

RE: REQUEST TO CONDUCT AN INTERVENTION STUDY WITH THE NATURAL SCIENCES TEACHER AT YOUR SCHOOL

I am a registered Masters in Science Education student at Rhodes University. My area of interest is integration of indigenous knowledge (IK) in Natural Sciences lessons. One of the principles of the National Curriculum Statement (NCS) is inclusion of IK and different world views in the Science Curriculum. However, teachers are encountering many problems with the inclusion of IK in the Science Curriculum, of which among them is lack of learning and teaching material that shows how this should be done in the classroom.

My study therefore aims at supporting teachers on how to integrate indigenous knowledge in Natural Sciences lessons. This will be achieved through co-developing model lessons that integrate indigenous knowledge in the topic of acids and bases in particular. Additionally, I would like to enable Natural Sciences teachers to develop their own model lessons that integrate indigenous knowledge.

The study will be conducted in three phases. The **first phase** requires participants to complete a questionnaire. The **second phase** of the study involves an intervention in the form of a workshop on training participants on the integration of IK in science lessons. At the same time, model lessons will be developed. After the intervention, **the third phase** of the study requires volunteer teachers to implement co-developed model lessons in their classrooms whilst I observe them.

I therefore request your permission to work with the Natural Sciences teacher form your school. Should you have any questions about the research, please feel free to contact me on 078 1522 740/ ingcalicoop@gmail.com or my supervisors Prof Ngcoza (k.ngcoza@ru.ac.za) and Dr Sam Khene (s.khene@ru.ac.za).

Yours Truly

.....

Magwentshu Thando

Principal's Consent form

I M.M. TSWABI the Principal of LONWABO P. SCHOOL School have read and understood the conditions under which this research project will be carried out. I understand that participation is voluntary and that the teachers who choose to participate are free to withdraw from the study at any time, and this will not prejudice them in any way.

I therefore agree/~~disagree~~ (delete inapplicable) that the teacher takes part in the research.

Signed .....

Date 30/05/2019

DEPARTMENT OF EDUCATION - EC
LONWABO PRIMARY SCHOOL
Tel: 047 873 5439
30 MAY 2019
P.O. BOX 6 EZIMELENI - 5334 4 FISHER STR 440 ZONE 1
PRINC

Principal's Consent form

I M.W. BANIMZI ,the Principal of W.R. JOMOLO P.S. School have read and understood the conditions under which this research project will be carried out. I understand that participation is voluntary and that the teachers who choose to participate are free to withdraw from the study at any time, and this will not prejudice them in any way.

I therefore agree/disagree (delete inapplicable) that the teacher takes part in the research.

Signed ..Bang.....

Date ...30-05-2019.....

DEPARTMENT OF EDUCATION E.C.
W.R. SOMOLO PRIMARY SCHOOL
TEL: 047 873 1167
30 MAY 2019
446 Fischer Street, EZIBELENI - 5320
PRINCIPAL: Bang

Principal's Consent form

I THEMBINKOSI MBEWU (PP) HOD, the Principal of NOGATE SPS School have read and understood the conditions under which this research project will be carried out. I understand that participation is voluntary and that the teachers who choose to participate are free to withdraw from the study at any time, and this will not prejudice them in any way.

I therefore agree/disagree (delete inapplicable) that the teacher takes part in the research.

Signed T.S Mbewu p.p (HOD)

Date 30-05-2019

DEPARTMENT OF EDUCATION
EASTERN CAPE PROVINCE
NOGATE S.P.S
2019 -05- 30
167 ZONE 2 - EZIBELENI
CELL: 082 712 4625
PRINCIPAL: pp T.S Mbewu (HOD)

Appendix E: Letter to the participants

NO 1 PEACOCK STREET
QUEENSTOWN

5320

01 June 2019

Dear Sir/Madam

RE: REQUEST TO BE A PARTICIPANT IN MY STUDY

I am a registered Masters in Science Education student at Rhodes University. My area of interest is integration of indigenous knowledge (IK) in Natural Sciences lessons. One of the principles of the National Curriculum Statement (NCS) is inclusion of IK and different world views in the Science Curriculum. However, teachers are encountering many problems with the inclusion of IK in the Science Curriculum, of which among them is lack of learning and teaching materials that show how this should be done in the classroom.

My study therefore aims at supporting teachers on how to integrate indigenous knowledge in Natural Sciences lessons. This will be achieved through co-developing model lessons that integrate indigenous knowledge in the topic of features of the moon in particular. Additionally, I would like to enable Natural Sciences teachers to develop their own model lessons that integrate indigenous knowledge.

The study will be conducted in three phases. The first phase requires participants to complete a questionnaire. The second phase of the study involves an intervention in the form of a workshop on training participants on the integration of IK in science lessons. At the same time, model lessons will be developed. With your consent, the data obtained will be transcribed word for word and analysed.

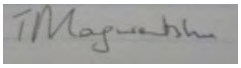
I therefore request you to be one of the participants in my study. Should you have any questions about the research, please feel free to contact me on 078 1522 740/ ingcalicoop@gmail.com or my supervisors Prof Ngcoza (k.ngcoza@ru.ac.za) and Dr Sam Khene (s.khene@ru.ac.za).

I henceforth request you to indicate your choice by ticking [√] in the appropriate box below.

Agree ☐ Not agree ☐ Signature: ……

Your cooperation will be highly appreciated

Yours Truly



…….

Magwentshu Thando

Appendix F: Consent form

Informed Consent Form: Natural Sciences Teachers

I ……., have read and understood the conditions under which this research project will be carried out. I understand that participation is voluntary and that if I choose to participate, I am free to withdraw from the study at any time, and this will not prejudice me in any way.

I therefore agree/disagree to take part in this research.

Signed ……

Date ……

Appendix G(a): Questionnaire

The purpose of this questionnaire is to get to know your experiences, perspectives and pedagogical insights on the integration of local/traditional/indigenous knowledge in science lessons. The information obtained in this questionnaire will be anonymous and your name will not be used. Please answer all the questions as freely and honestly as you wish.

PART A: **BIOGRAPHICAL INFORMATION OF TEACHERS AND SCHOOLS**

1. Gender

Male	**Female**

2. Age group (Tick one box)

20 - 25 yrs	**26 – 30**	**31 – 35**	**36 - 40**	**41 – 45**	**46 – 50**	**Above 50**

3. Ethnicity (tick the correct one)

Xhosa	**Zulu**	**Sotho**	**Tswana**	**Coloured**	**Others**

4. Qualifications (tick the qualifications you have)

PTD	**STD**	**BEd**	**ACE**	**HONS**	**MEd**	**PhD**	**Other**

5. School location where you teach (tick one)

Urban	**Rural**	**Semi-urban**	**Semi-Rural**

6. Teaching Experience in Natural Sciences/Physical Sciences/Life Sciences/Agricultural Science and total teaching experience?

Teaching experience in	Grade	Total teaching experience
Natural Sciences/Physical Science/Life Science (Choose one)		

7. Religion……

PART B: TEACHERS' EXPERIENCES, PERSPECTIVES AND PEDAGOGICAL INSIGHTS

1. What were your past **experiences** on the integration of local knowledge during sciences lessons?

(a) When you were taught as a **learner at school**?

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……

(b) When you were taught as a **student at tertiary level** (College, Technikon or University)?

……
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……

2. What have been your **experiences** of teaching science in your classroom?

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……

……
……

3. What do you **understand** by the term local knowledge?

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……
……
……

4. What are your **views** on the integration of local knowledge in science lessons?

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……
……
……
……

5. What **factors** do you think influence your **views** on the integration of local knowledge in sciences lessons?

……
……
……
……
…….

6. (a) What do you think what could be the **benefits** of integrating local knowledge in science lessons?

……
……
……

……
……

(b) What do you think could be the **challenges** for integrating local knowledge in sciences lessons?

……
……
……
……
……

7. What local knowledge do you think is important to learn during science lessons?

……
……
……
……
……

8. In your view, why do you think why it is important for learners to be taught such local knowledge during science lessons?

……
……
……
……
……

9. What do you think what could be the reasons why **other** science teachers

(a) **Integrate** local knowledge during their lessons?

……
……
……

……
……

(b) Do **not integrate** local knowledge in their lessons?

……
……
……
……
……

10. What else would you like to share with me regarding the integration of local knowledge in science lessons?

……
……
……
……
……

Thank you very much for your time to complete this questionnaire!!

Appendix G(b): Questionnaire (collated responses T1 to T4)

1. Part A: Bibliography information

Code	Gender	Highest qualifications	Ethnicity	Teaching experience in Natural Sciences (years)	Age group	School location	Religion
T1F	F	B Ed	Xhosa	1	26-30	Rural	Christian
T2F	F	B Ed	Xhosa	2	31-35	Rural	Christian
T3M	M	ACE	Xhosa	15	46 -50	Semi Urban	Christian
T4F	F	ECE	Xhosa	10	36-40	Urban	Christian

2. **Part B: Teachers' experiences, perspectives and pedagogical insights**

1: Past experiences on the integration of local knowledge during science lessons	
Code	**(a) When you were taught as a learner at school**
T1QF	I do not have experience
T2QF	I don't have experience
T3QM	When fermentation was explained teachers would make relevant examples with what we know already. Like making of Mqombothi.
T4QF	No response
Code	**(b) When you were taught as a student at tertiary level**
T1F	I do not have any experience
T2F	I was never taught even at tertiary
T3M	None that much
T4F	No response
2: Experience of teaching science in the classroom	
T1F	I have not used indigenous knowledge
T2F	My learners find it difficult to understand science, however with some experiments it helps to draw their attention
T3M	I think making examples of what they experiences everyday in their lives which is easy for them to understand the concepts
T4F	No response
3: Understanding of the term local knowledge	
T1F	Local knowledge are beliefs that our parents use to tell us about and we grew up knowing these beliefs were true

T2F	Local knowledge is some sort of belief on certain things or a way of trying to make someone understand something on a different perspective
T3M	It is indigenous knowledge acquired by people in a certain community, tribe and religion
T4F	Knowledge that already exists in the natural setting
4: What are your views on integration of local knowledge in science lessons	
T1F	I think local knowledge would help because it could make learners to understand science and would make them more interested.
T2F	Local knowledge does no come out with facts
T3M	It is important to integrate the local knowledge because you will be taking the learners from what they know
T4F	It would improve content mastery
5: Factors you think influence your views on the integration of local knowledge in sciences lessons	
T1F	Local knowledge could influence science lessons in a positive ways because learners will participate in class and help them understand science differently
T2F	With our learners now, you need to prove whatever you are telling them. Local knowledge has been taught by elders and you'll never really find out where they got that information from.
T3M	Learners are not blank they have something they know. Help to understand complex concepts. They relate the information with what is happen in their home.
T4F	Learning by doing, moving from unknown to the known.
6a: What do you think could be the benefits of integrating local knowledge in science lessons?	
T1F	Participation in class and more understanding at science differently from the curriculum. Learners will come up with new ideas and show interest in science.
T2F	There are no benefits
T3M	- It will create an appetite on the side of learners who study science - Learners will begin to see that science is involved in their daily lives
T4F	It would improve content knowledge and grasping of new knowledge
6b: What do you think could be the challenges for including local knowledge in science lessons?	
T1F1	The challenges could be that some of the local knowledge is not really true and that could affect the true facts of science lessons that are taught in class
T2F2	It will need evidience, facts

T3M	None that much
T4F4	There is less local knowledge documented and the older generation is slowly getting depleted
7: What local knowledge do you think is important to learn during science lessons?	
T1F1	Reflection caused by thunder storms. That knowledge has a link to science
T2F2	No response
T3M	- Knowledge about the our environment - Knowledge about interdependence of species - pollution
T4F	**P**hases of the moon, checking the weather from the moon
8: In your view, why do you think it is important for learners to be taught such local knowledge during science lessons.	
T1F	Because it could help them to be more active in class and link science to local knowledge
T2F	No response
T3M	It will make things easier for learners to understand science concepts
T4F	To create enthusiasm and critical thinking and creativity
9: What do you think what could be the reason why other science teachers:	
(a) Integrate local knowledge during their lessons	
T1F	Because some of the local knowledge are myths and some have a link in science. The link could help them understand science more appropriate
T2F	To help learners
T3M	- To make the lessons interesting to the learners - To make the lesson easily understandable
T4F4	To improve teaching and learning
(b) Do not integrate local knowledge	
T2F	Because some do not believe that local knowledge even exists, some do not integrate because of where they grew up
T2F	No response

T3M	- Because they are running away from passing incorrect information to the learners because the information has not been verified
T4F	There's scarcity of reference material to back your statements
10: What else would you like to share with me regarding the integration of local knowledge in science lessons?	
T1F	Local knowledge must ba taught in science lessons because they have a link with science somehow.
T2F	When we grew up, we were told to cover mirrors during lightning and sit behind the door down. It is making sense now that is because of the reflection that we were told to cover the mirrors.
T3M	Nothing more
T4FQ	It is very important because learners will learn with understanding rather than just cramming. Learning will be meaning and practical.

Appendix H: Semi-structured interview schedule

1. What do you understand by the term local knowledge?

2. What are your views on the integration of local knowledge in science lessons?

3. What local knowledge do you think would be important for learners to learn acids and bases?

4. What do you think what could be the **benefits** of integrating local knowledge in teaching the topic of acids and bases?

5. What do you think could be the **challenges** for integrating local knowledge in teaching the topic of the features of the moon ?

6. What else would you like to share with me regarding the integration of local knowledge in science lessons?

Annexure H (a): Interview transcript with T1

Me: Ma'am as you know I have been busy on my study on integration of indigenous knowledge to science and as you are a participant in this study, would you please permit me to interview you and this interview will be similar to the questionnaire you completed earlier.

T1: Okay

Me: Right, my first question is, what do you understand about Indigenous knowledge?

T1: Well sir, to me, the way I see it, Indigenous Knowledge is the way of which people are sort of controlled and made to believe certain things.

Me: Yes, yes.

T1: I would preferably describe Indigenous Knowledge as a way of which people are told certain things so that they can see themselves in a certain way of which is different from others.

Me: Alright, I see your point, but do you think it has got a place in science?

T1: In some aspects no, in others yes. Keep in mind that sometimes in Science we must prove things

Me:Yes,yes

T1: As a matter of fact, we often get confused by Indigenous Knowledge mainly because we don't have proof but if you were to sit down, take your time and look into it, it would make much more sense.

Me:Okay,okay I understand so Science is proven and has Indigenous Knowledge.

T1: It's not that we really have proof but yes.

Me: Yes I understand, so please tell me about any Indigenous Knowledge you know of.

T1:So let me make an example of Indigenous Knowledge, we grew up in a time period of which our parents made *amarhewu* so as we grew up we learnt that when making *amarhewu* you must allow *igwele livundiswe umzuzwana nje kheli hlale iintsukwana, kwenziwa intwana encinci zelithi xa liziswa apha ku senziwa kengoku uukhulu berhewu kugalelwe lanto incinci ibivundisiwe apha erhewini lonto ke ngokwe science ilenza irhewu lethu libile, libe mnandi liye kulancasa layo uba uyayiqaphela yindlela yokunyuswa kwe asidi phayana*. This is one of the things that when you look at them, you see one of the things that have that thing that connects to science but you cannot really define what it is. There are also things that our parents told us of which if you investigate

them you don't really know where they lead or why they are like that. Well I don't know if I should interpret more on that.

Me: Alright ma'a, Im actually interested on that

T1: Okay sir.

Me: I just want to check anything that you know about the moon.

T1:I remember when I grew up, I pointed at the moon and as I looked at it I noticed it looked like a woman or mother carrying her baby on her back with *inyanda* on her head.

S1: Okay

Me: Now we grew up being told a tale about this woman in the moon. The tale went like this…*there was a woman who was sent to the moon carrying the inyanda on her head and she never came back*. Sometimes the picture on the moon looked like a dog so the elders told us tales about dogs too, so this comes back to the fact that even though Indigenous Knowledge isn't so much related to Science that is why when they are put together they don't make that much sense but really if you look into it, there is something going on in the moon.

Me: Alright so tell me if we were to use or teach children about Indigenous Knowledge, how would it help them when teaching science?

T1: Sir, I wont lie, in actual fact, the kids of today are smart. They will ask questions about anything and everything. We would actually struggle if we were to teach Indigenous Knowledge however it would be pleasant if we were to teach or let them know of the way we did things and how they should see themselves and not remove Indigenous Knowledge completely. We would struggle in the sense of today, Science is much more advanced and it more likely to be based on experiments so today the children would expect things based on experiments but since we don't have those experiments or anything to experiment on then you just a teacher who is just speculating according.

Me: It's true, it's true I understand, what else would you like to share about Indigenous Knowledge?

T1: You see, about what I was talking about over Indigenous Knowledge, as we grew up we were told that when there is lightning we must cover up all mirrors in the house and when we ask our parents why, they don't give us a solid reason instead they would say to prevent lightning from burning down because of lightning, but in that little explanation nothing includes the mirrors that are covered up. Then when you look into it, it makes sense because mirrors reflect the lightning onto objects that can be set on fire easily so in conclusion first of all we must look into Indigenous

Knowledge to make sense, second of all it is important for children to know certain things about Indigenous Knowledge like the lightning and mirror as is it important and can keep them from certain dangers and lastly if we were to teach Indigenous Knowledge as teachers we would struggle and have challenges.

Me: Mhm alright, thank you very much ma'am.

T1: Thank you very much sir.

Annexure H (c): Interview transcript with T2

ME: Uh good m, good afternoon ma'am I wish to thank you *maan* for making up this time for this short interview I promise it's going to be short I understand it's the month end uh you need to go to town and do your own things but as you have responded to the questionnaire, I wish to triangulate everything there by these few questions maybe the first question that I should be asking is, your understanding of the term local knowledge, what do you understand about the term local knowledge?

T2: Thank you *meneer*, my understanding of local knowledge is that it is the things that elders used to tell us whilst growing up about the way things are done without really knowing their origin, these are things that we didn't really question but did because they were done whilst we were growing up

ME: Okay, okay alright can't you give me any example maybe of indiginous knowledge that-that you have in your area

T2: In my area it liked to rain, thunder and lightning would occur when this happened we were often told not to sit next to a window, not to carry water, to always sit down, cover mirrors and many more when there is lightning.

ME: Mhm, mhm then anything either about the sun the moon any knowledge maybe that you had?

T2: No *meneer* except for the fact that my brother when you look at the moon you see someone that looks like a woman carrying a child on her back and people liked to say that she deserted Earth long ago to stay on the moon

ME: Okay, alright, alright, alright ma'am what do you think could be the benefits of including local knowledge in science?

T2:Uh if you notice meneer local knowledge beats science a lot because the things that were told to us whilst growing up we are still practising them even now

ME: Okay, okay

T2: We also pass them on to our children and they also do them and when they are questioning us we tell them that we also didn't question

ME:Mhm, okay, okay so you are saying local knowledge is the best

T2: Yes it is the best I would say that meneer

ME: That indigenous knowledge is the best, but what would be the challenges of integrating IK to science?

T2: The challenge would be that they don't have anything that prove them like there is nothing that shows us that they happened because of A,B and C

ME: Mhm

T2: There is nothing that really shows the origin of these things and why they are being done.

ME: Alright, alright, alright

T2: But it's easy to pass it on to another person and they also listen

ME: Yes, yes, yes right, right just tell me anything that you would like to share regarding to the inclusion of local knowledge in science lessons

T2: I think meneer it's important to include the local knowledge that we have in classes but focus it in its origin

ME: Where does it come from?

T2:Why is it important for a certain thing not to be done, why should you not carry water when there is lightning, why should you sit down and not stand up near the window things like that, they explain it to you like that, because the children of today believe in facts.

ME: Mhm, mhm which means that's where science comes in

T2: Where it starts

ME: It explains why you have to do this and why do you have to do that. Ma'am thank you very much for your time thank you so very much for your time I am going to transcribe this, I will write it down and I am going to provide its transcript to you. Thanks a lot

T2: Thank you *meneer*

Annexure H (b): Interview transcript with T3

Me: UH ma'am njengoko usazi ba ndenza esi study sam on integration of indigenous knowledge to science, as ba uyi participant yesi study, ndicela mandikhe ndiku interviewe, le interview ibu hambelana na la questionnaire ubuyi gcwalisile.

T3: *Okay*

Me: Right, umbuzo wam wokuqala kuwe uthi, what do you understand about indigenous knowledge, wazi ntoni ngale indigenous… indigenous knowledge?

T3*:Mna, tata, titshala wam ndingathi i-indigiyous knowledge uh yindlela endi nothi xa ndiyibona uh yindlela e controla not to say uku controla but yindlela apho abantu abenziwa ukuba maba bielive kwizinto ezithile*

Me: Yes,yes

T3*: Iyasinceda ke ukucontrola izinto ezithle, mhlawumbi ke ngoko hamba kwakho kule questionnaire soye size cacisa ezizinto but i-indigiyous knowledge yindlela apho abantu baye baxelelwe izinto so that bazi bone nge ndlela ethile*

Me: Alright, alright, alright, alright ndiyakuva ke, now wena xa ucinga, do you think it has got place in science?

T3*: Kwezinye izinto ewe kodwa kwezinye hayi, kaloku khumbula mfundisi wam into bangabana iScience amaxesha amaninzi kugfuneka ukhombe kuyo izinto*

Me: Yes,yes

T3*: Kanti siye sibethakale ngengoku apha kwi indigenous knowledge ufumanise into bangabana asina proof nangona nje xa unoyi hlalela phantsi uthi wayi jonga uqond'ba iya yenza yona isense*

Me: Okay,okay I understand so iScience its proven and i-indiginous

T3*: Ayina proof ncam*

Me: There is yes I understand, I understand, just just tell me any, any, any indigenous knowledge oyaziyo

***T3**: Mamela tata nhe ndizakwenzela umzekelo kwizinto ze indigiyous knowledge uh, sikhula kusenziwa amarhewu so ekukhuleni kwethu kusenziwa amarhewu beliya li vundiswe umzuzwana nje kheli hlale iintsukwana, kwenziwa intwana encinci zelithi xa liziswa apha ku senziwa kengoku uukhulu berhewu kugalelwe lanto incinci ibivundisiwe apha erhewini lonto ke ngokwe science ilenza irhewu lethu libile, libe mnandi liye kulancasa layo uba uyayiqaphela yindlela yokunyuswa kwe asidi phayana. Uh zizinto ke eziye zenzeke othi xa uzibona ubone ukuba eyi ezizinto ezi zinabo ukudibana kancinci ne science but azikwazeki kuchazeka kakuhle uh zikhona ke nezinye izinto esiye sizibone ke size xelelwe in fact sasizixelelwa nanga bazali bethu but ke azina bu, awungekhe uyilandelele ncam uba kahle kahle lento inoba unobangela wayo yintoni andazi ke noba mfundisi ufuna ndigxile na kwizinto ezinjalo.*

Me: Alright, alright ma'am oyena mdla wam nhe

***T3**: Ewe tata*

Me: I just want to check anything that you know about the moon

***T3**: Ndikhula ndikhomba inyanda oh I mean sorry inyanga enyangeni ubuthi xa uyi qwalasela ufuman'singathi kune picture ekhoyo uh engathi ngumntu ongu mama obeleke umntwana ethwele inyanda*

Me: Okay

T3: Now sikhula ke sixelelwa into yobangobana, eli bali mhm mfundisi elibali lithi kuho umama owathi… ngamanye amaxesha ide ibe ngathi yinja mfundisi kuthwe because sizama ukwazi bangabana ba yintoni lanto isenyangeni kuthwe ngelinye Ixesha "kukh'umama owathunywayo akaazange abuye ethwele inyanda wayo hlala enyangeni watshonelwa lilanga kude kuthethwe nangezinto zezinja yilanto ke benditshilo ke mfundisi intoba hayi noko i-indigiyous knowledge ingathanda uyi betha iscience xa zino hlanganiswa ngoba awungekhe uyichane ncam-ncam uba yintoni, kodwa nawe ungakh'uqwalasele ikhona into eyenzeka enyangeni, enyang, enyangeni.

Me: Alright, alright, alright, alright ma'am just just tell me mhlawumbi ba singa sisebenzisa loo indigenous knowledge ebantwaneni ingaba nceda ngantoni xa utitsha iscience

***T3**: Hayi tata wa andi funi phosisa abantwana bangoku ba smart, abantwana bangoku bafuna izinto they will question you nangantoni na, singa sokola if singa yi faka however ibingase kengoku ezinye zez'zinto just bangabana ngokwendlela kengok esiba khulisa ngayo nangokwe ndlela abantwana bethu aba mabazibone ngayo izinto singayisusi kakhulu but with uba sithi siayenza kwi science singathanda uku bethakala abantwana bethu bathanda ii-experiments, if awuna experiment then awukwazi ba , ungutitshala ogqibeleleyo kubo*

Me: It's true, it's true I understand mhlawumbi what else would you like to share about indigin…, anything that you would like to share to me about i-indiginous knowledge

***T3**: Uh uyabona tata kulento bendithetha ngayo ye indigiyous knowledge, indiginyous knowledge uh ndingakuxelela uh uh besithi xa sikhula uthi ba uyabona kuya baneka kuthwe masi gqume iimirrors kuthwe ke ngabazali benzelba ntongbana ilightning ingabethi indlu itshe yonke lonto leyo bebengayicacisi ngokwaneleyo uba kahle kahle yintoni lena nathi njenga bantwana besikhawuleza ukugquma but ke xa sele uyi bona lento lena nyani it makes sense into yobangabana ilightning with I mirror kungakho ireflection and all that but kengoku kulanto besiyekuyo ntongabana kubalulekile izinto bazazi kodwa ke ukuzi teacher singathanda ukuba nechallenges ezinkulu.*

Me: Mhm alright, thank you very much ma'am

***T3**:Enkosi kakhulu mfundisi wam*

Me: Ndiyabulela kakhulu, ndiyabulela kakhulu, I will transcribe it ndi,u-ndi- uyifunde wena

***T3**: Enkosi*

Me: Thank you very much

Appendix I: Collated responses from semi-structured interviews

1. What do you understand by the term local knowledge?	
CODE	**RESPONSE**
T1SSF	- Well sir, to me, the way I see it, Indigenous Knowledge is the way of which people are sort of controlled and made to believe certain things. - I would preferably describe Indigenous Knowledge as a way of which people are told certain things so that they can see themselves in a certain way of which is different from others.
T2SSF	- Uh thank you meneer, uh local knowledge is related to those things that we were often told to us by elders at home whilst growing up - People used to believe that you do a certain thing because of a certain reason - We have grown up and we grew up believing that these things are real, I could say that some of these things are maybe real but some of them I don't really think so my mentor, some no - An example meneer, do you notice when a dark storm is coming - When we grew up we would go out to beat tins and zincs and shout Eee*embo*! Eembo! Get in front when the storm was approach - Sometimes that rain, it used to be dark and you would see it disappear and the sky would be visible again and the storm would end up not falling
T3SSF	- Thank you meneer, my understanding of local knowledge is that it is the things that elders used to tell us whilst growing up about the way things are done without really knowing their origin, these are things that we didn't really question but did because they were done whilst we were growing up. - In my area it liked to rain, thunder and lightning would occur when this happened we were often told not to sit next to a window, not to carry water, to always sit down, cover mirrors and many more when there is lightning.
2. What are your views on the inclusion of local knowledge in science lessons?	
CODE	**RESPONSE**
T1SSF	- In some aspects no, in others yes. Keep in mind that sometimes in Science we must prove things - As a matter of fact, we often get confused by Indigenous Knowledge mainly because we don't have proof but if you were to sit down, take your time and look into it, it would make much more sense.

T2SSF	- I think it's important my meneer because it usually has a link that it has involving Science.
T3SSF	- No response
3. What local knowledge do you think would be important for learners to learn the topic on stellar bodies?	
CODE	**RESPONSE**
T1SSF	- I remember when I grew up, I pointed at the moon and as I looked at it I noticed it looked like a woman or mother carrying her baby on her back with inyanda on her head. - Now we grew up being told a tale about this woman in the moon. The tale went like this…there was a woman who was sent to the moon carrying the inyanda on her head and she never came back. Sometimes the picture on the moon looked like a dog so the elders told us tales about dogs too, so this comes back to the fact that even though Indigenous Knowledge isn't so much related to Science that is why when they are put together they don't make that much sense but really if you look into it, there is something going on in the moon.
T2SSF	- For example the eeembo thing that I have told you or let me make an example. In my area we had a man who when we asked him the time - He would check it in the sun, he would look at where the sun was, what it said, and he would tell you the time is closer to a certain time
T3SSF	- No meneer except for the fact that my brother when you look at the moon you see someone that looks like a woman carrying a child on her back and people liked to say that she deserted Earth long ago to stay on the moon
4. What do you think could be the benefits of including local knowledge in teaching the topic of stellar bodies?	
CODE	**RESPONSE**
T1SSF	- Sir, I wont lie, in actual fact, the kids of today are smart. They will ask questions about anything and everything. We would actually struggle if we were to teach Indigenous Knowledge however it would be pleasant if we were to teach or let them know of the way we did things and how they

	should see themselves and not remove Indigenous Knowledge completely. We would struggle in the sense of today, Science is much more advanced and it more likely to be based on experiments so today the children would expect things based on experiments but since we don't have those experiments or anything to experiment on then you just a teacher who is just speculating according.
T2SSF	- Uh if you notice meneer local knowledge beats science a lot because the things that were told to us whilst growing up we are still practising them even now - We also pass them on to our children and they also do them and when they are questioning us we tell them that we also didn't question
5. What do you think could be the challenges for including local knowledge in teaching the topic of acids and bases?	
CODE	**RESPONSE**
T1SSF	- I think the challenges meneer are that some of these things are not really true - And now facing science facts some of the indiginous knowledge stories they do not really link to the science we teach in classes daily
T3SSF	- The challenge would be that they don't have anything that prove them like there is nothing that shows us that they happened because of A,B and C - There is nothing that really shows the origin of these things and why they are being done.
6. What else would you like to share with me regarding the inclusion of local knowledge in science lessons?	
CODE	**RESPONSE**
T1SSF	You see, about what I was talking about over Indigenous Knowledge, as we grew up we were told that when there is lightning we must cover up all mirrors in the house and when we ask our parents why, they don't give us a solid reason instead they would say to prevent lightning from burning down because of lightning, but in that little explanation nothing includes the mirrors that are covered up. Then when you look into it, it makes sense because mirrors reflect the lightning onto objects that can be set on fire easily so in conclusion first of all we must look into

	Indigenous Knowledge to make sense, second of all it is important for children to know certain things about Indigenous Knowledge like the lightning and mirror as is it important and can keep them from certain dangers and lastly if we were to teach Indigenous Knowledge as teachers we would struggle and have challenges.
T2SSF	Uh I meneer can say that I would like indiginous knowledge to be included during class sessions. I am saying this because maybe it may make science lessons easier and learners could be able to participate in class and some learners would be able to understand science in a version that could draw their attention and become more interested in the depth of science, so I think including some indiginous knowledge could be a major factor in science lessons.
T3SSF	I think meneer it's important to include the local knowledge that we have in classes but focus it in its origin Why is it important for a certain thing not to be done, why should you not carry water when there is lightning, why should you sit down and not stand up near the window things like that, they explain it to you like that, because the children of today believe in facts.

Appendix J: Lesson Plan 1

DATE:	**OBJECTIVES: LEARNERS MUST BE ABLE TO:**
TOPIC: The Moon	
Content & Concepts: Features of the moon	• Recognise the value of knowing stories of the moon from other cultures • Formulate their own story of the moon • Explore the role of moon in diverse cultures through stories.

Terminology	Feature, Shape, Surface, Phase, Waning, Waxing, Crescent	
SPECIFIC AIMS	**1. DOING SCIENCE**	**X**
	2. KNOWING THE SUBJECT CONTENT & MAKING CONNECTIONS	**X**
	3. UNDERSTANDING THE USES OF SCIENCES & INDIGENOUS KNOWLEDGE	**X**

PROCESS SKILLS

X	**Accessing & recalling Information**		**Identifying problems & issues**		**Doing Investigations**
X	**Observing**	**X**	**Raising Questions**	**X**	**Recording Information**
X	**Comparing**	**X**	**Predicting**		**Interpreting Information**
	Measuring		**Hypothesizing**	**X**	**Communicating**
	Sorting & Classifying		**Planning Investigations**		

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
The Moon is like a ball of rock that orbits, or goes around, Earth. The Moon is about one-quarter the size of our planet. It is about 238,857 miles from Earth. Moons are natural satellites, or celestial bodies that orbit a planet. Some planets, like Jupiter, have several moons; Earth has only one. It takes about 28 days for the Moon to orbit Earth. Together the Moon and Earth orbit the Sun, which takes about 365 days. The Moon's surface is rocky and dusty and full of craters, most likely made by rocks that crashed into the Moon. The surface is not flat, but has mountains and valleys. Your children should know that scientists have not yet found evidence of plants or animals (or aliens) on the Moon. However, scientists believe there might have been water on the Moon.	**LESSON 1** **CLASS DISCUSSION** • Have your learners collect, read or narrate different folktales, stories, or books about the Moon in the class. • What cultures have stories about a rabbit in the Moon? • What stories do different communities tell about how the Moon came to be? • Compare and contrast the stories. Then have students write and illustrate their own stories and tales about the Moon. Have students share their work with the class) • Allow the learners to tell if each story told is a true story or a false story. • Learners should provide reasons why they think the story is true or false. • Ask the learners the following questions to check their understanding at this point: - Why are there so many stories about the moon? - Are any stories wrong? - Which story did you like the most? - What part of the story made this story your favourite? • Explain this task to the learners as follows:	Community Member Stories about the moon from different sources Pictures of the moon

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
	- We need to appreciate that there are many different cultures in the world and they all have different stories for the same thing. - There are many ways to look at something. People can learn about other cultures by listening to their stories.	
	LESSON 2 • Start the lesson by asking two or three learners to reflect about what they learnt the previous day. • Explain to the learners that the stories people told about the moon tried to explain what the moon was and why it looked the way it did. • Ask the learners about: 1. Who are the main people in each story? 2. How important was the Moon in the story? 3. What part did the Moon have?	

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
	Explain to the learners that: The Moon is like a ball of rock that orbits, or goes around, Earth. The Moon is about one-quarter the size of our planet. It is about 238,857 miles from Earth. Moons are natural satellites, or celestial bodies that orbit a planet. Some planets, like Jupiter, have several moons; Earth has only one. It takes about 28 days for the Moon to orbit Earth. Together the Moon and Earth orbit the Sun, which takes about 365 days. The Moon's surface is rocky and dusty and full of craters, most likely made by rocks that crashed into the Moon. The surface is not flat, but has mountains and valleys. Your learners should know that scientists have not yet found evidence of plants or animals (or aliens) on the Moon. However, scientists believe there might have been water on the Moon. Wrap the lesson by giving learners the following homework.	
ASSESSMENT	Read the following story and answer the questions that follow: THE STORY OF THE MOON AND THE SUN Once upon a time the Sun and the Moon were married and they had many children known as Stars.	

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
	The Sun was very fond of his children and he always wanted to hold them. But he was very hot and so the stars got burnt. The stars did not like to be burnt and so they always ran away to hide when he came up into the sky. But the stars liked to be with their mother, the Moon, because she was the cool one. The Moon had markings on her face and she was beautiful. This made the Sun very jealous, and he was angry with the Moon. So that is the reason why the Sun chases the Moon out of the sky. On some days you can see her in the daytime but the Sun almost never catches her. There are times when the Moon comes between the Sun and the Earth, and we see the Sun go dark. These events are called eclipses of the Sun. **QUESTIONS** 1. In this story, who is the father, who is the mother, and whoare the stars? *The Sun is the father, the Moon is the mother, and the stars are the children.* 2. In this story, what happens in the morning when the Sun comes up?	

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
	The stars run away to hide in the morning. 3. How do you know that this story is not true? *The Sun and Moon cannot get married; they cannot have children; the Sun does not have feelings like jealousy and anger.* ***For the teacher:*** *This story helps people remember what happens in the day and night sky, and people enjoy stories like this. However, science tells a different kind of story; science tries to explain things that happen by using science knowledge about the Sun and stars.* 4. The story does help us remember some true facts. Name one of the true facts we get from the story. *The Sun and the Moon move across the sky on almost the same paths; the full Moon sets in the west when the Sun comes up in the east; sometimes the Sun does go dark when the Moon passes in front of it.* *5.* Why are the Sun and the other stars hot? *They are big balls of gas; one kind of gas is changing into another kind of gas and that is why they are so hot.* 6. In the real sky, why do the stars disappear when the Sun comes up? *The Sun is much brighter than the stars and so we cannot see the light from the stars, but they are still there in daytime.*	

CONTENT	TEACHING & LEARNING ACTIVITIES	Resources
	7. In the real sky, can you ever see the Moon in daytime? *Yes, some days you can see the Moon in the sky.*	
TEACHER REFLECTION		

Appendix K: TSPCK components

Table 1: Shows components for transformation of knowledge (Adapted from Mavhunga & Rollnick, 2016)

CONTENT SPECIFIC COMPONENTS	INDICATORS	ANALYSIS
Learner Prior Knowledge (LPK)	What learners already know including common misconceptions known in a topic.	
Curricular Saliency (CS)	Identification of the major concepts around the topic without which understanding of the topic would be difficult for learners.	
What is difficult to understand (WDU)	Refers to the gate keeping concepts which are difficult to understand often	

	because they cause conflict with previously established understanding	
Representations (RP)	Refers to combinations of representations at macro, symbol or sub-microscopic levels that may be employed to support explanation, example, illustrations, metaphors, analogies, models, simulations	
Conceptual Teaching Strategies (CTS)	Refers to teaching strategies derived from the consideration made from other components. Particular misconceptions, particular learner/learners and particular educational purpose. It excludes general teaching methodologies.	

Appendix L: Journal Reflection

Instruction: Answer all the following questions

1. What have you learned from this lesson?

   ……

   ……..

   ……..

2. What have you enjoyed in this lesson?

   ……

   ……

   ……

3. What have you <u>not</u> enjoyed in this lesson?

   ……

   ……

   ……

4. How can the lesson be improved?

   ……

   ……

   ……

Appendix M: categories and emerging themes from qualitative responses of the questionnaire

QUESTION	CATEGORIES	SUB THEMES	THEMES	THEORY
1	When fermentation was explained teachers would make relevant examples with what we know already. Like making of Mqombothi	Pedagogical insights		
2	I think making examples of what they experiences everyday in their lives which is easy for them to understand the concepts	Connections with everyday life		**Mavuru & Ramnarain**
3	Local knowledge are beliefs that our parents use to tell us about and we grew up knowing these beliefs were true It is indigenous knowledge acquired by people in a certain community, tribe and religion	Understanding the origin of LK		
4	I think local knowledge would help because it could make learners to understand science and would make them more interested. It is important to integrate the local knowledge because you	Benefit of IK/ Implications in a classroom setup		

	will be taking the learners from what they know			
5	Local knowledge could influence science lessons in a positive ways because learners will participate in class and help them understand science differently With our learners now, you need to prove whatever you are telling them. Local knowledge has been taught by elders and you'll never really find out where they got that information from. Learners are not blank they have something they know. Help to understand complex concepts. They relate the information with what is happen in their home.	Learner participation in science classroom		
6 (a)	Participation in class and more understanding at science differently from the curriculum. Learners will come up with new ideas and show interest in science.	Disposition		

	- It will create an appetite on the side of learners who study science - Learners will begin to see that science is involved in their daily lives				
6 (b)	The challenges could be that some of the local knowledge is not really true and that could affect the true facts of science lessons that are taught in class It will need audience, facts There is less local knowledge documented and the older generation is slowly getting depleted	Dispositions/ Understanding			
7		Reflection caused by thunder storms. That knowledge has a link to science - Knowledge about the our environment - Knowledge about interdependence of species	Understanding		

		- Pollution **P**hases of the moon, checking the weather from the moon			
8	Because it could help them to be more active in class and link science to local knowledge It will make things easier for learners to understand science concepts To create enthusiasm and critical thinking and creativity	Knowledge/ Pedagogical insights			
9 (a)	Because some of the local knowledge are myths and some have a link in science. The link could help them understand science more appropriate To make the lessons interesting to the learners To make the lesson easily understandable	Dispositions/ Pedagogical insights/ Understanding			
9(b)	Because some do not believe that local knowledge even exists, some do not integrate	**Dispositions/ Pedagogical insights**			

	because of where they grew up - Because they are running away from passing incorrect information to the learners because the information has not been verified There's scarcity of reference material to back your statements			
10	Local knowledge must ba taught in science lessons because they have a link with science somehow. When we grew up, we were told to cover mirrors during lightning and sit behind the door down. It is making sense now that is because of the reflection that we were told to cover the mirrors.	**Dispositions/ Pedagogical insights**		