Exploring Grade 9 Physical Science teachers' views and experiences on the inclusion of indigenous knowledge in their lessons: A Namibian case study

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By

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DECLARATION OF ORIGINALITY

I ***Fredrick Simataa Simasiku (13s7222)*** declare that this thesis has not been submitted for a degree in any other university apart from Rhodes University and I declare that it is my own work, written in my own original words. Where I have cited the words or ideas of other researchers, these have been acknowledged using complete references according to the Departmental guidelines.

Signature: ______________________ Date: 16 March 2017

ABSTRACT

There is extensive research on the fact that the learning of science is assisted through the inclusion of the prior everyday knowledge and local knowledge that learners bring from home and from within their communities. It is precisely for this reason that the Namibian Learner Centered Education (LCE) curriculum encourages teachers to include learners' prior everyday knowledge in their science lessons. However, the inclusion of traditional knowledge/local knowledge or indigenous knowledge (IK) and how this should be done has been largely ignored both in the Namibian school science curriculum and textbooks. It is against this background that this study sought to explore teachers' views and experiences on the inclusion of IK in Physical Science Grade 9 lessons as well as the pedagogical strategies that they use.

This research used a mixed methods approach (quantitative and qualitative data were collected) which was underpinned by the interpretive paradigm. Within the interpretive paradigm, I employed a case study approach. The study was carried out in the Endola education circuit of the Ohangwena Region. Essentially, the study explored three things: Firstly, the views, experiences and pedagogical strategies of Grade 9 Physical Science teachers on the inclusion of indigenous knowledge in their lessons. Secondly, to find out what factors enable the teachers to integrate their local knowledge into Physical Science lessons? Thirdly, to look at constraints that affect Grade 9 Physical Science teachers in the use of local knowledge in their science lessons.

Data were collected using questionnaires and semi-structured interviews. The data obtained were validated in two ways, firstly, the data were triangulated from different data gathering techniques, and secondly, validation was done by member checking of the transcribed scripts. To make meaning from the data generated, Vygotsky's (1978) socio-cultural theory was used as a lens to analyze the data. The data generated were coded inductively and presented in graphs, tables and descriptive texts to make meaning.

The findings from the research revealed that teachers in the Endola circuit do make some efforts to include indigenous knowledge in their lessons. Furthermore, teachers seemed to grasp the benefits and constraints that come with the inclusion of indigenous knowledge in their science lessons. For example, it emerged that indigenous knowledge enables learners to link what they are taught in the science classroom to what is happening in the community or at home, thereby enhancing their understanding of the concepts. Topics such as acids and bases, friction, combustion, static electricity and pressure emerged as some of the topics in which teachers include indigenous knowledge. On the other hand, the issue of language, textbooks and lack of indigenous knowledge by teachers affects the way teachers are able to include IK in their lessons.

This study thus recommends that teachers should explore different indigenous practices that can be linked to the topics in the curriculum or syllabus to enhance learning and teaching. Furthermore, they need to involve local communities that possess indigenous knowledge to help in delivering indigenous practices during the lessons. Lastly, teachers and communities should start developing learning and teaching support materials that are useful when local knowledge is included.

DEDICATION

This thesis is dedicated to my late father, James Simasiku Chiyasa who taught me to be an African boy and the spirit of Africanism he stored in me, my late sister Imelda Mutinta Simasiku, my mother, Rosemary Neo Muhongo for teaching me to be a responsible African child. My three lovely sons, Ntelamo, Simataa and Matengu for inspiring me to continue the struggle to this level and beyond, and finally my lovely wife Pumulo Iness Ntelamo for encouraging me to study. I love you all and may God bless you all!

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INSPIRATION FOR MY STUDY

I was inspired by the way I was brought up as an African boy exposed to different local/traditional knowledge from a tender age. As a boy I was trained how to set traps for birds and other small animals, fishing using traditionally made nets called *mukuko* in Silozi, ploughing, curving and so on. I was also exposed to different medicinal plants that were used whenever I was sick to treat different diseases. We prevented mosquito bites at night by burning dried cow dung. The smoke from the cow dung chased the mosquitoes away and this protected us from the most feared insect in the world. I need to find out what is in cow dung that repels mosquitoes. Is it the same chemical as the one used in mosquitoe coils?

My mom used to make traditional beer and she was the expert in this. I observed and learnt what steps should be taken for the whole process to be completed. At school we were taught a similar process but it was not linked to what I knew and learnt from home. My dad used to make hoes, spears and many other equipments by using *mapukuta*, this *mapukuta* works like a blast furnace, the metal would be put in the charcoal and they would use *mapukuta* to blow air into the charcoals, the temperature would be very high and the metal would be red in colour before they took it out to hammer it into different shapes. This knowledge was totally ignored during my schooling and the teachers used to refer to me as a fisherman because of the cultural belief that whatever your father does it is what you will inherit in future.

This encouraged me to embark on this project to learn more about how current teachers with a new teaching philosophy include local/traditional knowledge in their science lessons.

> Indigenous or local knowledge refers to a complete body of knowledge know-how and practices maintained and developed by people, generally in rural areas, who have extended histories of interaction with the natural environment (Boven & Morohashi, 2002, p. 9).
>
> Integrating local knowledge in science lessons might help learners to take ownership of what is learnt in the classroom and also it might help learners to participate more actively in the lessons (Boven & Morohashi, 2002, p. 9).

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ABBREVIATIONS AND/OR ACRONYMS

IK – Indigenous Knowledge

LC – Local Knowledge

LCE – Learner Centred Education

LoLT – Language of Learning and Teaching

NMBEC – Namibia. Ministry of Basic Education and Culture

NME – Namibia. Ministry of Education

NCBE - National Curriculum for Basic Education

NIED – National Institute for Educational Development

NMBESC – Namibia. Ministry of Basic Education, Sport and Culture

PEK – Prior Everyday Knowledge

SK – Scientific Knowledge

SWAPO – South West Africa Peoples' Organisation

TCE – Teacher Centred Education

TK – Traditional Knowledge

WK – Western Knowledge

ZPD – Zone of Proximal Development

QUAL- Qualitative

QUANT- Quantitative

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CHAPTER ONE

SITUATING THE STUDY

> *The traditional methods of science teaching and learning are today widely regarded as rigid, stereotyped and syllabus and textbook bound (Kambeyo, 2012, p. 2).*

1.1 Introduction

This chapter introduces my study, which sought to explore Grade 9 Physical Science teachers' views, experiences and pedagogical strategies on the inclusion of local/traditional knowledge (indigenous knowledge) in their lessons in the Endola circuit, Ohangwena region. As the Ohangwena region is situated in a remote region in the country, most schools are found in rural areas. This study was thus initiated by the assumption that the indigenous people living in the region have considerable knowledge about various cultural practices which could potentially be used during science lessons.

The first section in this chapter outlines the background of the curriculum in the Namibian context, the background of Learner Centered Education (LCE) and my teaching experience on the use of traditional/local knowledge or indigenous knowledge (IK). The next section outlines the problem statement, potential value of my study, the gap this study sought to fill in Namibia, the research goal and questions, followed by the context of the study. The conceptual framework and theoretical framework that informed this study are also discussed. The limitation of the study, definitions of key concepts used in the thesis and the thesis outline are provided. The chapter ends with some concluding remarks.

1.2 Geographical location of Namibia

Namibia is a semi-desert country situated on the Atlantic coast of southern Africa. The country is divided into 14 political regions governed by a Governor and these political regions influence the way education is run in each region. Each region has its own regional Director that oversees the administration of education in that region. Before 2013 the country had 13 educational regions and Kavango was divided into two regions, namely, the Kavango West and Kavango East. The fourteen educational regions are as follows: Zambezi, Kavango West, Kavango East, Ohangwena, Oshana, Oshikoto, Omusati, Omaheke, Otjozodjupa, Kunene, Karas, Khomas, Erongo and Hardap

Region. The region in which this study was conducted is Ohangwena region which consists of nine circuits of which Endola is one.

Ohangwena Region where Endola circuit is located

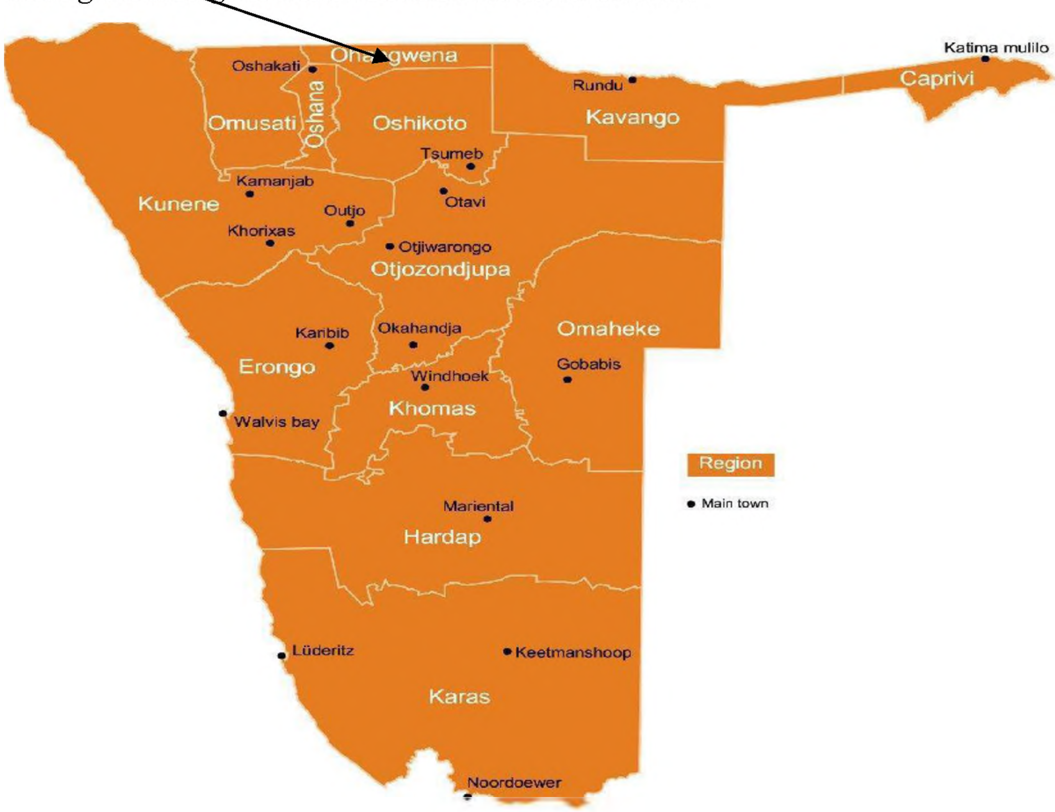


Figure 1.1 Shows the Namibian Map
(*http://nsa.org.na/microdata1/index.php/catalog/19/download/136)*

1.3 Curriculum in Namibia since 1990

After independence in 1990, the educational philosophy in Namibia changed from teacher centered education (TCE) to learner centered education (LCE) which is documented in a range of policies (Namibia. Ministry of Education (NME), 2010) and the Namibian Ministry of Basic Education and Culture (NMEC) (1999) teacher centred education was more streamlined with the focus on the teachers, syllabuses, and textbooks without considering the knowledge the learners brought from home into the classroom. These traditional methods of science teaching and learning are today widely regarded as rigid, stereotyped and syllabus and textbook bound as highlighted by Kambeyo (2012) in the epigraph. This teaching method regarded learners as 'empty vessels' that needed to be filled with scientific knowledge supplied by the syllabus and textbooks.

Unlike TCE, the aim of LCE is to focus on learners as the centre of teaching and learning. That is, LCE entails teaching and learning processes whose emphasis is on what the learners should "know, understand, do and be able to become" as opposed to what the teacher should achieve (Nyambe, 2008, p. 16). "A knowledge-based society requires a learner-centred education approach to teaching and learning, the point of departure is always what the learners already know and can do, and then acquiring new knowledge through ways of working which are relevant and meaningful for them" Namibia, Ministry of Education (NME, 2010, p. 4). The NME (Curriculum 2010) indicates that a knowledge-based society requires people who are healthy, well-educated, skilled, pro-active and with a broad range of abilities. It further elaborates that a knowledge-based society is one where knowledge is created, transformed, and used for innovation to improve the quality of life.

It is believed that these aspirations could be achieved in part through using LCE (Nyambe, 2008). LCE has many goals including one that encourages teachers to build learning starting with the prior everyday knowledge that learners bring to the classroom. It therefore provides teachers with an opportunity to use the learners' local knowledge as this would be embedded in their prior everyday knowledge. However, it is not clear from the curriculum documents on how local/traditional knowledge (indigenous knowledge) is supposed to be included in the science lessons to encourage meaningful teaching and learning.

Meaningful learning is more likely to occur if the teachers use learner-centered education, whereby they utilize the learners' experiences and knowledge in the learning process through using teaching and learning methods in which the learners interact with and reflect on the subject matter as proposed by the socio-cultural perspective on learning (Vygotsky, 1978). Understanding in science lessons could be promoted if teachers use the local knowledge (IK) of learners as a supplement to the information in the textbooks (Hanisi, 2006; Kambeyo, 2012; Kota, 2006; Mandikonza, 2007; van Wyk, 2002). For the learners to acquire new knowledge they need to build on what is known. For example, learners are exposed to traditional knowledge/local knowledge/indigenous knowledge (IK) in their homes and communities. Such knowledge could be used as a starting point where appropriate in science classrooms.

The NMBEC, (1996) also emphasizes that schools have a special responsibility to use the curriculum guide together with various subject syllabi to identify locally relevant content within a common framework so that learners could experience their education as being meaningful for them. This curriculum is intended to allow teachers to use the local/traditional knowledge of learners that are relevant to the topics that are taught in science classrooms. For example, Kambeyo (2012) researched on teaching acids and bases using the prior everyday knowledge of learners in Namibia, Omuthiya area. It emerged from his study that learners showed that they knew about acids and bases from their local/traditional knowledge but it was difficult for them to move from their everyday knowledge to scientific knowledge. This is what Aikenhead and Jegede (1999) refer to as cultural border crossing. It is against this backdrop that this study sought to explore how local/traditional knowledge is being used and can be used as prior knowledge in science classrooms.

One might, for example, wonder how the learners might act when they are taken to a place or homestead where traditional beer is made as demonstrated by Uushona (2013). Using local knowledge to teach science concepts might bring about the active engagement of learners during the lesson. For instance, Kuhlane (2011) found that "learners manipulated the resources in order to understand the concepts or to shift their understanding of these concepts (from known to unknown)" (p. 77).

In addition to being able to manipulate resources, Mwamwenda (2004) argues that learning takes place as a result of active engagement between the teachers and learners. Therefore, teachers need to allow learners to take an active role by participating in whatever is being taught and learned in the classroom. Mwamwenda (2004) further believes that the type of learning that enables learners to take an active role promotes deeper and more enduring understanding as opposed to the practice of rote learning. This indicates that the IK of local people could be useful if it is included in science lessons to forge the link between IK and western science (WS) (Kibirige & van Rooyen, 2006).

In my experience as a teacher of Physical Science I have observed that learners grasp new knowledge if a good foundation is laid for the topic they are learning. Such foundations included related concepts recently covered and local practices that they can relate to in order to supplement what is documented in their textbooks. Looking at the proposed teaching philosophy that Namibia inherited in 1990 which was implemented in 1993, learner centred education (LCE) requires learners to construct their own knowledge using the knowledge they brought from home or have already learnt. It seems then that the more learners can call on their prior everyday knowledge when confronted with concepts in the science classrooms, the more meaningful their understanding of these concepts will be.

However, Nyambe and Wilmot (2012), and Chisholm and Leyendecker (2008) critique the implementation of LCE in sub-Saharan Africa specifically in Namibia and South Africa. They argue that the policy makers in sub-Saharan Africa adopted the LCE because of its promise of the social goals attached to it but they did not have a clear understanding of the pedagogy (Chisholm & Leyendecker, 2008). Learner Centred Education (LCE), Outcome Based Education (OBE) and the National Qualifications Framework (NQF) caused conflicting values extending into areas of the interface between education, curriculum, context and culture (ibid). Lending support, Nyambe and Wilmot (2012) explained that there was a lack of understanding of the concept of LCE in teachers and teacher educators on how the policy should be implemented. To date LCE still presents a challenge to teachers, especially in under-resourced schools.

1.4 Statement of the problem

Most Physical Science teachers from Grade 8-12 might not have been exposed to any training on how to infuse prior knowledge, including indigenous knowledge during their lessons. Instead, they might still be relying on the textbook as the only resource available for the learners to construct science knowledge. Instead of infusing IK as prior everyday knowledge in science lessons, learners might be grappling with how to connect western science (WS) with local knowledge to enhance learning. Despite Kibirige and Van Rooyen's (2006) assertion that that the learning of science can be enhanced through the inclusion of prior everyday knowledge and local knowledge, the inclusion of IK in Physical Science in Namibian context is still under-researched. This study sought to fill these gaps in research by exploring teachers' views, experiences and pedagogical strategies when they include local/traditional knowledge in their lessons.

1.5 Significance of my study

Although studies have been done by Mukwambo (2012), Kambeyo (2012), Uushona (2013) and Shifafure (2014), on the inclusion of IK in specific topics in Physical Science there are still some areas of research that remain unanswered. For instance, Mukwambo (2012) researched trainee teachers' engagement with prior everyday knowledge and experiences when teaching Physical Science concepts on pressure and Kambeyo (2012) researched how Grade 9 Physical Science learners made sense of the topic on acids and bases through exploring their prior everyday knowledge and experiences. Shifafure's (2014) study focused on how teachers mediated learning on the topic of distillation in Grade 11 Physical Science, while Uushona (2013) looked at how Grade 9 learners made sense of the fermentation and distillation process through exploring the indigenous practice of making the traditional alcoholic beverage called *Ombike*. They all focused on IK in a specific topic in science, but my research looks at the overall inclusion of IK in any science topic and teachers' views and experiences with including IK in science in general.

My study focused on Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) during their science lessons. I believe that this study could be of significance by:

- Informing textbook writers and those engaged in training science teachers of the preconceptions and experiences of teachers who include IK in their science lessons;
- Inform teachers on the potential use of IK as prior knowledge that learners bring to class;
- Inform the curriculum designers on the importance of the inclusion of IK in the Physical Science curriculum;
- Pave the way for other studies on the intervention needed to ensure the inclusion of local/traditional knowledge in Physical Science lessons; and
- Help me as a Physical Science teacher to improve my teaching strategies.

1.6 Research goal and questions

The main goal of this study was to explore Grade 9 Physical Science teachers' views and experiences on the inclusion of traditional knowledge/local knowledge (indigenous knowledge) in their lessons and the pedagogical strategies that they use in mediating learning of science concepts.

To achieve this goal, the following questions guided the study:

Research Questions:

- What are Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) in their science lessons?
- What kinds of local/traditional knowledge (indigenous knowledge) do Grade 9 Physical Science teachers have or do not have when teaching Physical Science topics?
- Where and how do Grade 9 Physical Science teachers use local/traditional knowledge (indigenous knowledge) in their science lessons?
- What factors enable or constrain Grade 9 Physical Science teachers to make use of local/traditional knowledge (indigenous knowledge) in their Physical Science lessons?

To answer these questions, I made use of data generated by the use of questionnaires and interviews.

1.7 Definition of key concepts

- **Teacher centred education** is the teaching method that regards teachers as the only source of knowledge in the classroom and learners are seen as passive receivers of such knowledge.
- **Learner centred education (LCE)** is an approach to teaching and learning that comes directly from the National goals of *equity* (fairness) and *democracy* (participation). It is an approach that requires teachers to put the needs of the learners at the centre of what they do in the classroom, rather than the learner being made to fit around whatever needs the teacher has decided upon.
- **Indigenous Knowledge** is the knowledge the learners acquire through their interaction with community members and it is about their cultural beliefs and other cultural norms.
- **Prior everyday knowledge** is the knowledge the learner acquires from home, community and peers.
- **Indigenous people (local knowledge)** are people that have lived in an area over a period of time and have developed a connection with the environment and know the ecology of their local environment.

- **Oshikundu** is a traditional drink that is made at home for family consumption in Ovamboland, it is made from fermented sorghum flour.
- **Zone of proximal development** it is the distance between the actual developmental 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 (Vygotsky, 1978).
- **Scaffolding** is the process of helping learners to move from one level of schema to the next for them to be able to achieve what they could not do before.
- **Socio-cultural theory** is the theory that views learning as the integration into a community of practice in which social actions are identified and classroom activities designed (Jaworski, 1993).
- **Western knowledge** is the knowledge that is regarded as truth and facts documented in the textbooks
- **Scientific knowledge** is the knowledge that has been scientifically proven

1.8 Thesis outline

This thesis comprises six chapters, outlined as follows.

Chapter One: Situating the study

This chapter outlines the research context and the aims and the potential value of the research. The reasons for carrying out my research are outlined and the research goals are listed. The chapter ends with a review of the definitions of concepts used in the thesis.

Chapter Two: Literature review

This chapter discusses the literature relevant to my study. Firstly, it focuses on the curriculum's views on teaching using LCE in Namibian context. Secondly, the literature on IK and PEK is provided. The significance of both prior everyday knowledge and indigenous knowledge in science subjects are examined. The chapter also discusses the theoretical framework that informed my study.

Chapter Three: Research methodology

This chapter narrates the methodology used to collect data for my research. In this chapter I reveal my research as mixed methods research with dominant QUAL over quant. It also clarifies the methods used to gather data to answer my research questions. The methods of data generation such as questionnaire and interview (semi-structured interview) are discussed in more detail in this chapter. I also describe the sampling techniques used to select the participants for both the questionnaires and interviews. The chapter concludes with a description of the triangulation methods used to validate the data and the ethical considerations. It also highlights some limitations that occurred during the data generation methods.

Chapter Four: Data presentation, analysis and discussion

In this chapter, I present, analyze and discuss the data generated from questionnaires and interviews. I critically analyze and categorize data into categories to be examined using my theoretical framework and literature. In this chapter the findings of the research are presented in relation to the literature in Chapter Two.

Chapter Five: Summary of findings, recommendations and conclusions

In this chapter, the summary of the findings, recommendations, reflections and conclusion are summarized in detail. It also provides recommendations for areas of future research and reflects on the overall research process. The limitations of the research are discussed.

1.9 Concluding remarks

In this chapter, I situated my study by looking at the background of my study in the Namibian context. The chapter also presented my research goal, questions, and the significance of the study as well as the data generating techniques used in the study. Furthermore, the definitions of key concepts used in the thesis and the thesis outline are provided. The chapter ends with some concluding remarks to pull the threads together.

The next chapter describes the relevant literature that was consulted on the inclusion of local/tradition knowledge (indigenous knowledge) in Physical Science.

CHAPTER TWO

LITERATURE REVIEW

A cumulative body of knowledge and beliefs handed down through generations by cultural transmission, about the relationship of living beings with one another and with their environment. These sets of understandings, interpretation and meaning are part of a cultural complex that encompasses language, naming and classification systems, practices for using resources, ritual, spirituality and worldview (Shizha, 2007, p. 305).

2.1 Introduction

Chapter one provided the reader with a road map as to what to expect in this thesis. This chapter focuses on literature relevant to the study. It discusses the composition of local/traditional knowledge (indigenous knowledge or IK) and prior everyday knowledge (PEK), and how they might relate to the Namibian Physical Science curriculum. The chapter further discusses key aspects of the socio-cultural theory that was used to make sense of the data.

2.2 The roots of learner-centered education (LCE)

Learner-centred education (LCE) has historical roots that extend back to the time of Socrates (400 B.C.). But it was the work of continental philosophers of the late 19^{th} and early 20^{th} centuries who questioned the nature of childhood and how children should be educated which helped to spread the influence of LCE to North America and the United Kingdom (UK) (Schweisfurth, 2013). Another major influential thinker and writer on the subject in the early 20^{th} century was American philosopher and educationist John Dewey (1916), who linked 'progressive' pedagogy to the development of democratic skills and dispositions in learners.

Contributing to the rich foundational literature on LCE are writers such as Vygotsky (1978) and Bruner (1966a & 1996b), who understood learning via a constructivist paradigm. This means that they construed knowledge as co-constructed by learners and teachers, with teachers playing a social, interpersonal and facilitative rather than whole-class instructive role (Schweisfurth, 2013). As pointed out in Chapter One, the constructivist paradigm is the teaching theory in which LCE is embedded. The LCE was adopted in Namibia after independence in 1990 and introduced in 1993. It was the brain-child of a newly independent country's intent on breaking with the past.

It has been argued that LCE as a concept is best studied phenomenologically, allowing for different definitions and interpretations across different contexts (Schweisfurth, 2013). This is so because LCE involves many facets of learning that cannot be fully understood by studying interactions over a short period of time. This research, however, is not phenomenological and only sought to understand one part of LCE, the influence of IK on the learning of science concepts. Notably, this understanding has the potential to enrich LCE in the subject.

Chisholm and Leyendecker (2008) point out that learner-centred education was first introduced by Jean Piaget (1962), John Dewey (1938a & 1938b), and Lev Vygotsky (1978). The main theoretical basis of learner-centred education is Vygotsky's cognitive psychology. LCE has become an international pedagogy and most countries in the world have incorporated elements of it in their education system (Nyambe, 2008; Nyambe & Wilmot, 2012). According to Nyambe (2008), LCE is "a world model of teaching" (p. 56). An important aspect was contributed by the Brazilian Paulo Freire (1972), who helped shape the international landscape of adult education, in particular, with his notion of conscientisation. Chisholm and Leyendecker (2008) assert that LCE is one of the most pervasive educational ideas in the world, including in contemporary sub-Saharan Africa. Yet, despite Namibia's learner-centred curriculum, a learner-centred approach to teaching is frequently operationally absent (ibid.).

LCE in post-apartheid Namibia also traces its historical roots to the education activities of the South West Africa People's Organisation (SWAPO) in exile, in education centres such as the refugee school in Kwanza-Sul, Angola (Nyambe, 2012). According to Chisholm and Leyendecker (2008), learner-centred education is faithful to the way the mind works. Its main tenets are that:

- Knowledge is not transmitted; it is constructed in the mind of the learner. Learning is a mentally active process, and learning results from personal interpretation of knowledge;
- Learning is a process in which meaning is developed on the basis of prior everyday knowledge and experience. Prior everyday knowledge and experience are determined by culture and social context. In this context, aspects of the experience that the learners have had can be referred to as local/traditional knowledge (indigenous knowledge); and
- Language influences culture and thinking, and is central to learning and the development of higher cognitive processes (Chisholm & Leyendecker, 2008).

These key features of LCE were integrated into the Namibian curriculum, and teachers are expected to be guided by LCE in their teaching.

2.3 Curriculum views on learner-centered education (LCE) in the Namibian context

In the Namibian education system, 'curriculum' is the term used to describe the official policy for teaching, learning and assessment; the curriculum also gives direction to planning, organizing and implementing teaching and learning (The National Curriculum for Basic Education (NCBE), 2010, p. 1). Curriculum refers to the knowledge and skills learners are expected to learn, which includes the learning standards or learning objectives they are expected to meet; the units and lessons that teachers teach; the assignments and projects given to learners; the books, materials, videos, presentations, and readings used in a course; and the tests, assessments, and other methods used to evaluate learners' learning (Hidden Curriculum, 2014). In 1990, when Namibia became independent, there was a move to reform the education system that had been in place during colonial times.

The education system was changed in 1993 from teacher-centred education (TCE) to learner-centred education (LCE). Nyambe (2008) recognizes that LCE is rooted in constructivism, progressivism and the Freirean model of education, and that it is informed by principles and practices drawn from these models. In order to achieve this transformation, the Ministry of Education established the National Institute for Education Development (NIED) to design and oversee the implementation of the new curriculum. The policy for LCE as formulated by NIED (Namibia. Ministry of Education and Culture, 1999) is as follows:

> An approach that means that teachers put the needs of the learner at the centre of what they do in the classroom, rather than the learner being made to fit whatever needs the teacher has decided upon. This means that activities which put the learner at the centre of teaching and learning must begin by using or finding out the learners' existing knowledge, skills and understanding of the topic. The teacher is responsible for developing different activities to find out what the learners already know about the topic. Then teachers develop more activities that build on and extend the learners' knowledge. (p. 5)

This suggests that the point of departure is always what the learners already know and can do. They then acquire new knowledge through ways that are relevant and meaningful for them, and learn how to apply their knowledge creatively and innovatively (Namibia. Ministry of Education, 2010). It is for these reasons that the LCE promotes teachers' use of learners' everyday knowledge gained from home or the environment, that can be described as indigenous/local or traditional knowledge and prior everyday knowledge.

According to Mubita (1998), when the curriculum is designed, the situation of learners should be placed at the centre. That is, their experience both in school and outside school should be taken into consideration. In support of this, NIED (Namibia. NIED, 2003) indicates that teachers should be able to select content and methods on the basis of shared analysis of learners' needs; moreover, they should use local and natural resources as alternative materials.

Additionally, in a learner-centred classroom, learners are expected to learn from each other. The Namibian Institute for Educational Development (NIED, 2003) argues that learning should be seen as an interactive, shared and productive process. Thus, teachers need to create learning environments conducive to learners being creative, innovative, and exploring their environment in such a way that they build from what they know in ways that enable them to learn new things, either in groups or individually.

2.4 Indigenous knowledge and prior everyday knowledge

Infusing indigenous knowledge (IK) into science lessons has the potential of introducing background knowledge in the form of contextualized examples. For example, concepts in distillation, fermentation and rates of reactions taught in Science can be linked to certain cultural practices or activities engaged in by indigenous communities, such as making *Oshikundu* (fermentation) and *Ombike* (distillation) (Uushona, 2013). Indigenous communities brew different kinds of traditional alcohol for consumption. To refer to this when teaching Physical Science could allow learners to become familiar with the language of science used in the distillation of alcohol. This could involve learners in classroom talk as proposed by Lemke (2001).

2.4.1 Understanding of PEK and IK in local contexts

Prior everyday knowledge and local/traditional knowledge (indigenous knowledge) are intertwined concepts, and it is difficult to separate them without critically analyzing the context in which the knowledge has been acquired. Some prior everyday knowledge (PEK) comes in the form of indigenous knowledge (IK). In this section I examine definitions of and perspectives on both concepts.

2.4.1.1 Prior everyday knowledge (PEK)

Some scholars claim that prior knowledge is the knowledge that learners gained from previous grades, while others claim that it is the cultural knowledge learnt in the home before arriving at school (Meyer, 2004; Roschelle, 1995). Prior knowledge serves as the anchor of all the knowledge we acquire. Science knowledge is often just a refined product of some PEK. When we acquire knowledge by building from our existing knowledge, we replace and re-use some of the prior everyday knowledge (Meyer, 2004).

Moreover, Meyer (2004) indicates three different ways in which students obtain prior knowledge: first, is knowledge from the previous grades' 'prior teaching', second, is informal learning experiences (TV or Museums) and the last is general life experience (p. 974). Lending support, Kambeyo (2012) defines prior everyday knowledge as the knowledge that learners possess which has been gained from their surroundings (environments), from parents, friends and from previous lessons.

Roschelle (1995) explains that new knowledge does not replace prior everyday knowledge; rather new knowledge re-uses prior everyday knowledge. He further indicates that knowledge begins with the selection of ideas from everyday experience or PEK. Ideally, learners build on a foundation of robust and accurate prior everyday knowledge, forging links between previously acquired and new knowledge that helps them construct increasingly complex and robust knowledge structures (ibid).

Teachers need to plan their teaching around the learners' prior everyday knowledge. So, in order to help learners make the best use of new knowledge, teachers need to build from the foundation that learners have laid either from previous grades or from their home environments. Teachers need to design tasks that require learners to build from their PEK. But incorporating everyday knowledge to full effect for learning is a skill that needs to be learnt. Roschelle (1995) affirms that to help learners make the most of the new experience (classroom content) teachers need to understand how prior everyday knowledge affects their learning in the classroom.

Learners are at the centre of their learning and they need to be creative and innovative when constructing new knowledge. Kasanda, Lubben, Gaoseb, Kandjeo-Marenga, Kapenda and Campbell (2005) note that the natural curiosity and eagerness of all young people to learn, to investigate and make sense of their widening world must be nourished and encouraged by the use of challenging and meaningful tasks.

According to Rivet and Krajcik (2008), novice learners do not always make connections between new information and prior everyday knowledge or everyday experience in ways that are productive for learning. Some researchers have argued that due to the underdeveloped knowledge structures and the lack of experiences of novice learners, engaging them in effective theory-building in everyday contexts which can be considerably complex may be overly optimistic and, at times counterproductive (Kasanda, et al., 2005; Meyer, 2004). So, teachers need to contextualize the content to be taught for the learners and find the best way to incorporate the prior everyday knowledge of learners during their science lessons (Stears, Malcolm & Kowlas, 2003).

Moreover, Williams and Lombrozo (n.d.) argue that PEK that relates to the features of a topic allows learners to discover the underlying thematic pattern and learn the topic more quickly. Also, it has been found that teaching science depends on teachers' understanding of the continuity and connections within the content area (Otero & Nathan, 2004). This suggests that teachers should be aware of the PEK that learners bring to their science lessons. Without this understanding teachers may not be able to elicit or build from the prior everyday knowledge of learners.

Nevertheless, learning can take place when learners are re-contextualizing, re-prioritizing or refining the parts of the knowledge to be learnt (Roschelle, 1995). If learners do not re-contextualize what they are learning with their prior everyday knowledge, it will be difficult for them to learn. Prior everyday knowledge (PEK) is properly understood not as a cause of errors or success, but rather as the raw materials that conditions all learning (ibid). Roschelle (1995) concurs with Svinicki (1994) who stated that the goal of learning is to incorporate new information into the existing organization of memory; a learner then uses this existing structure to assimilate new information. Learning can be the result of prior everyday knowledge being used to process knowledge at school. The memory structure we gain from home needs to be activated and restructured to make meaning in the context of science lessons. For the restructuring to happen, it needs time to repeat the knowledge over and over again. The current research has determined that, learners learn if there is a link between what they are doing and related to the topic (Svinicki, 1994).

However, not all PEK leads to learning, instead it could be the source of misconceptions. That is, prior everyday knowledge may have unintended negative consequences on the learning of learners. Research tends to characterize prior everyday knowledge as conflicting with the learning process, and thus tries to suppress, eradicate or overcome its influence (Roschelle, 1995). Not all prior everyday knowledge is useful during teaching and learning (Taylor, 1999) and so teachers need to be more aware of the learners' PEK before it is incorporated into the lesson.

Furthermore, PEK needs to be tested and evaluated first before it is linked to the concepts in the lesson. If learners' prior everyday knowledge conflicts with the new content, the presented material information risks being distorted (Campbell & Campbell, 2009). Roschelle (1995) asserts that teachers have the impression that learners need prior everyday knowledge to learn new concepts, but PEK can mislead learners to arrive at unconventional interpretation of concepts. PEK can be intertwined with IK and in some cases they are used interchangeably.

2.4.1.2 Understanding the concept Indigenous Knowledge

Indigenous knowledge (IK) has been defined by many scholars in order to achieve an understanding of the concept. Scholars such as Ogunniyi and Ogawa (2008), Hays (n.d.) and Kibirige and Van Rooyen (2006), Dziva, Mpofu and Kusure (2011) have done research on IK in the past and came up with definitions of the concept. According to Dziva, et al. (2011), IK refers to the philosophies, indulgences and expertise developed by long resident societies in their interaction with their natural surroundings and other people. Indigenous knowledge is defined by Mukwambo, Ngcoza and Chikunda (2014) as a micro-culture of a particular community, developed in response of the cultures' need to understand, predict and influences its environment over a long period of time and passed on from generation to generation (Kibirige & Van Rooyen, 2006). Ogunniyi and Ogawa (2008, p. 177), point out that "indigenous knowledge stands for an idea or system of thought peculiar to the so-called 'native' of a particular geographical location or socio-cultural environment". They further point out that an indigenous knowledge system refers to the combination of knowledge systems encompassing technology, social, economic and philosophical learning or education, and the legal and government system (ibid).

That is, IK is the knowledge that each community or culture has that differs from community to community. There is IK that all African people have in common and IK that differs based on the culture, ethnicity, and geographical location for example. In Namibia, for instance, Bushmen who live a nomadic life style, have IK that concentrates on hunting and gathering of food while in northern Namibia their IK is more concerned with farming, the same applies to people who make their living from fishing. IK is a cumulative body of knowledge and beliefs handed down through generations by cultural transmission, about the relationship of living beings with one another and with their environment**.** These sets of understanding, interpretation and meaning are part of a cultural complex that encompasses language, naming and classification systems, practices for using resources, ritual, spirituality and world view (Shizha, 2007).

Hays (n.d.) defines indigenous knowledge as a complete knowledge system with its own concepts of epistemology, philosophy and scientific and logical validity, which can only be learned and understood by means of a pedagogy traditionally employed by these people themselves. Kibirige and Van Rooyen (2006) further indicate that IK is locally derived from interactions between people and their environment. Thus, it is not easily shared with members of another community. As I alluded to above, IK depends on various factors such as, culture, ethnicity and the geographical location of the community. This knowledge is developed over a long period of time and it is difficult to disseminate to other cultures as it is region specific.

Mapara (2009) refers to IK as a local knowledge that is unique to a given culture or society. IK is defined as the form of knowledge that has originated locally and naturally (ibid). This research sought to understand how Physical Science teachers in the Endola circuit include local knowledge (indigenous knowledge) in their lessons by using LCE. Local knowledge includes traditional knowledge. The next section attempts to build an understanding of traditional knowledge.

2.4.1.3 What is local/traditional knowledge?

Local or traditional knowledge (TK) is the knowledge that is associated with the traditional or cultural beliefs of people living within a given area. Lewis and Ramani (n.d.) defined traditional knowledge as a "body of knowledge built by a group of people living in close contact with nature and it includes a system of classification, a set of empirical observation about the local environment and system of self-management that governs resource use" (p. 1). This knowledge is more culturally oriented and is based on the connection between people and their environment.

Hansen and Van Fleet (2003) define TK as the information that people possess in a given community, based on experience and adaptation to a local culture and environment, have developed over time, and continue to develop. This knowledge is used to sustain the community and its culture and to maintain the genetic resources necessary for the continued survival of the community (ibid).

2.4.2 Indigenous Knowledge (IK), Local knowledge (LK) and Traditional Knowledge (TK)

As I have indicated above, PEK and IK are intertwined and it is difficult to separate the two concepts without knowing how the knowledge was acquired. The concepts IK, LK and TK can thus be used interchangeably. The common ground is that this is the knowledge acquired through the interaction with the environment and it is transferred orally from generation to generation (Kibirige & Van Rooyen, 2006). The word 'traditional' does not mean 'old knowledge' but it refers to the way knowledge has been acquired that reflects the traditions of the communities (Hansen & Van Fleet, 2003). That is, it is not about relating to the nature of the knowledge itself, but to the way in which that knowledge was created, preserved and disseminated (Cocks, Alexander & Dold, 2012; Hansen & Van Feet, 2003).

When a teacher uses knowledge that learners have acquired from home and link it to the topics in the syllabus, it is referred to as PEK. When the teacher infuses traditional practices to teach science concepts, for example, traditional brewed drink called *Oshikundu* to teach concepts like, fermentation, catalyst, rates of reactions and so on, it is referred to as local knowledge, traditional or indigenous knowledge. Boven and Morohashi (2002) clarify that "indigenous knowledge is the local knowledge that is unique to a given culture or society, in addition local knowledge focuses more on agriculture, health care, food preparation, education, natural resource management, and a host of other activities in rural communities" (p. 12).

Moreover, IK may be related to a common practice seen in the communities that are indigenous to a specific area or the emphasis might be on the long history of the practice, and in this case it is often called traditional knowledge (Boven & Morohashi, 2002). Both local, traditional and indigenous knowledge are interrelated and are characterized by the words such as locally bound which means indigenous to specific area, culture and context, non-formal knowledge, orally transmitted and generally not documented, dynamic and adaptive, holistic in nature and closely related to survival and subsistence for many people worldwide (ibid). PEK and IK may have useful benefits in science lessons provided they are used properly to allow learners to integrate their PEK with western science.

2.5 The use of PEK and IK in teaching Physical Science

Teachers should build on the knowledge the learners have acquired from their previous grades or from home as they interact with more knowledgeable people. Both concepts are needed when teaching Physical Science in order for the learners to reconnect with their environment. Research, has found that learners enjoy the subject content that allows them to link to their own IK.

Mukwambo, et al. (2014) agree with Kibirige and Van Rooyen (2006) by asserting that IK is a legacy of knowledge and skills unique to a particular indigenous people and involving wisdom that has been developed and passed on over generations by the use of the trial and error approach. When incorporating IK in their lessons, teachers need to know how to use it to benefit the learners when they translate local science into western science otherwise it could affect the learners and the learning and teaching process.

According to Ogunniyi and Ogawa (2009), African indigenous people classify soil using color, texture and structure. Even before studying school science most African learners have accumulated a wealth of holistic knowledge about their environment (classification of plants and animals, weather condition, soil types, seasonal changes, tracking game, various methods of conservation, finding water sources, curing diseases) which school science with its compartmentalized disciplines have tended to displace rather than accommodate (ibid). This knowledge can help learners to develop their cognition when they link the subject content to their local knowledge. This interaction between LK and subject contents is valuable as local people are knowledgeable in many aspects of the science curriculum, such as agriculture, pests and soil types.

Many African countries have ignored the inclusion of IK in science classrooms, and this makes teaching and learning more difficult by not starting where the learner is and building on what they already know (Kibirige & Van Rooyen, 2006). Yet, learners enjoy the process of linking new knowledge to their IK and making new meaning that they can claim as their own. Kibirige and Van Rooyen (2006) posit that owning a type of knowledge brings joy and satisfaction to learners and it is highly likely that such learning will increase their retention of the new knowledge. Incorporating IK into science lessons encourages learners to change the meaning of their experience and that meaning is then constructed through shared experience. However, IK has negative implications if not included in the right way in lessons.

Not all IK is valuable or useful in science lessons; some IK creates contradictions between the curriculum and the IK of African people. Mukwambo, et al. (2014) argued that we need to be aware that IK is not a bag of knowledge waiting to be tapped into and dispensed. Instead, there is a need to critically analyze it before it can be used, to expose any contradictions that might come with it, or be entailed by it. Most science concepts are not yet developed in the indigenous language and according to Mukwambo, et al. (2014), science concepts are not always explicit in most indigenous practices, but the Africanisation of the school science curriculum calls upon the teachers and learners to attach scientific explanation to IK. They believe that the Africanisation of the science curriculum may allow more examples of indigenous knowledge to be used in the classroom. For now, the curriculum does not give that freedom to the teachers to include or test the knowledge from home (IK). Teachers are influenced by the curriculum and they do not see the need for IK in school science. Hence, teachers need to increase their knowledge about IK for them to be able to incorporate it into the curriculum.

Similarly, Shizha (2007) argues that bias was detected when teachers in Zimbabwe were asked how they incorporated IK, culture and traditional beliefs and customs into their lessons. This bias was influenced by the national curriculum that does not incorporate IK into the science curriculum and also the use of English as the Language of Learning Teaching (LoLT). Indigenous science and language are viewed as irrelevant to the understanding of 'modern' scientific values and skill that are practiced internationally (ibid).

Furthermore, textbooks are a hindrance to the successful integration of IK because they document facts and truth. Teachers rely on documented information and accept it as legitimate knowledge (Shizha, 2007). Since IK is not documented, tested and proven valid, it is difficult for teachers to include it in their lessons unless they have extensive knowledge about it.

Textbooks might not support teachers in including the indigenous knowledge of local people as they are the only sources that teachers use to teach and implement the curriculum. Since not all teachers are teaching in their local environment, it might be difficult for them to integrate the culture or prior everyday knowledge of the culture as different cultures have different IK. For the authors to include IK in the textbooks, curriculum designers need to include it in the curriculum. Ogunniyi and Ogawa (2004) point out that although curriculum developers recognize the obstacles in the way of implementing such curriculum changes, they nevertheless call on science educators (teachers) to create the courses and make the curriculum work.

According Aikenhead and Jegede (1999), the cultural clashes between learners' life-world and the world of western science challenges science teachers who embrace science for all. Cultural clashes can occur and teachers have to be sensitive when learners cross from their life-word (indigenous knowledge) into the scientific world of knowledge. When confronted with this disagreement, learners understandably invent ways to avoid constructing scientific knowledge, or store the constructed scientific knowledge in their mind out of harm's way to prevent it from interfering with their IK (ibid). This change from one world of knowledge to the other requires the teacher to manage the two through collateral learning.

Lastly, the dilemmas and contradictions that arise from the integration of western science and indigenous knowledge in science education is complex, not only in terms of curriculum transformation but also in terms of teachers' education and pedagogical practices within science lessons (Mhakure & Mushaikwa, 2014). For IK to be integrated into the curriculum, teachers need to have the background knowledge from that local community in order to be able to teach there as IK is context-dependent (Kibirige & Van Rooyen, 2006) and defines community members' identities (Mhakure & Mushaikwa, 2014). The term identity refers to a person's beliefs, attitudes, emotions and dispositions towards IK, WS and their role in Physical Science lessons (ibid).

Hence, Mhakure and Mushaikwa (2014) posit that to produce teaching and learning materials on the inclusion of IK and WS and to instruct pre-service and in-service teachers on multicultural science learning and teaching environments may require time and resources that most African governments are not willing to give. Research needs to be carried out to determine which IK can be linked to specific topics in the curriculum.

In the same vein, Mukwambo, et al. (2014) propose that Africanisation of the school science curriculum might encourage teachers to embrace cultural beliefs in their science lessons and to engage with them. So, teaching materials that involve both IK and PEK need to be developed not only by curriculum designers but teachers need to be involved from different cultures so that the materials suit their respective cultures. Educators should arrange for learners to visit and experience life with knowledgeable people in their communities such as elderly people, scientists, community leaders and scholars of folklore (Klein, 2011). This type of project provides many opportunities to teach indigenous science (Ogunniyi & Ogawa, 2004).

Ogunniyi and Ogawa (2008) and Maselwa (2004) further showed that the most effective ways to encourage teachers to emphasize science and IK in their classroom is to engage them in a long-term mentoring process in the form of dialogue, argumentation, role modeling, and explicitly reflective instruction approaches within a conceptual change framework. Teachers need to have in-depth knowledge of the curriculum for them to be able to incorporate what is in the curriculum into their lessons. They need to be more knowledgeable about the culture and the IK of the learners before attempting to integrate it into their lessons. IK has a strong link with the culture, traditional beliefs and the environment where people live.

Maselwa (2004) argues that, for the teacher to be able to incorporate IK into their lessons, they need to be knowledgeable about the subject content knowledge and be mindful of the elicitation and incorporation of learners' prior everyday knowledge into their teaching and learning. This would encourage confidence in front of the learners, and would help to clear all the misconceptions that might come with both PEK and IK. These the misconceptions that come with IK can distract the learning process if neglected by the teachers.

In short, teachers need to be educated about the importance of integrating both PEK and IK into their science lessons. This can only be done if the institution of higher learning include IK in their curriculum and train teachers on how to use IK in science, specifically Physical Science.

2.6 Physical Science curriculum and IK

In many African countries, however, opponents of the inclusion of IK in science education and its values, argue that IK refers to the historical and ancient practices of African people as illogical, outdated, and no longer relevant in today's world of science education curriculum (Mhakure & Mushaikwa, 2014). Instead, IK is embedded in both historical and current practices which are unique to people in a specific geographical area and still sustain the majority of rural populations in Africa (ibid). Education systems in sub-Saharan Africa have been deprived by Western knowledge and most African states did not have a chance to document their indigenous knowledge before the West colonized them (Mapara, 2009). The lack of education also contributed to the lack of documentation of IK. Despite this, not all indigenous knowledge was neglected and most of the existing societies still practice what they regard as their knowledge and cultural heritage (Cocks, et al., 2012).

Songs were one of the forms of education that most African indigenous people could use as a tool to teach the new generation about the chiefs, trees, traditional herbs and many others (Mapara, 2009). Today a science teacher can use these songs in the classroom, for example, the topic on sound waves (Liveve, 2016). Songs are still used as a form of communication for the African child.

Dziva, et al. (2011) argue that if the learner-centred approach is to be taken seriously it should include the learners' traditional knowledge which they bring into their science classrooms. The curriculum that allows learners to integrate their indigenous knowledge with science knowledge is what Aikenhead and Jegede (1999) called cultural border crossing. Cultural border crossing can serve science teachers, the 'pedagogical culture workers' who make the culture of science accessible to all their learners (ibid). The knowledge from home (IK) and science subject content cross examine each other and where it agrees, the learner master the subject content and where it disagrees, the content is examined and learned. Dziva, et al. (2011) indicate that the difference between scientific and indigenous knowledge continues to create barriers to meaningful collaboration, as does the widespread assumption that science is superior to other knowledge systems. This concurs with Aikenhead and Jegede (1999) who showed that in 90% of learners, the movement between the micro-culture (IK) of their family and the micro-culture (science knowledge) of school science is not smooth and often limits their success in science.

Furthermore, the Physical Science syllabi were developed in a clear and simple style in order to convey the ethos of learner-centred education. Learner-centred education presupposes that teachers have a holistic view of the learner, valuing the learner's life experience as the focal point of learning and teaching and teachers should therefore select learning content and methods on the basis of the learners' needs within their immediate environment and community (Namibia. NCBE, 2010). The indigenous knowledge system has been ignored in the National Curriculum for Basic Education (NCBE) in Namibia. However, the life experiences and learners' needs within their immediate environment and community (Namibia. NCBE, 2010) may reveal a ray of light on the inclusion of IK. The Ministry of Education might have seen the importance of indigenous knowledge in the education system in Namibia by suggesting that the teacher must be able to identify the needs of the learners, the nature of the learning to be done, and the means to shape learning experiences accordingly (Namibia. MoE, 2010).

This does not give the teachers the freedom to include IK in totality and test it in examinations. The implementation of the National Curriculum has proven problematic because there is a gap between the theory and practice. What is done at school does not link to what is done at home, especially when it comes to the indigenous knowledge of the African people. Teachers often wonder what exactly is expected of them in practical terms (Kibirige & Van Rooyen, 2006). This is another shortcoming in the Namibian curriculum; the integration between theory and practice.

Le Grange (2007, p. 582) affirms that any “science curriculum that does not take particular account of the indigenous worldview of the learner risks destroying the framework through which the learner is likely to interpret concepts”.

Science subjects in particular require the input of life experiences. The curriculum does allow for IK to be integrated in the lesson. A topic such as fermentation, for example, making traditionally brewed beer in the Zambezi Region called (*Chikontini or 7 days*), distillation making (*Kachipembe*) (Shifafure, 2013), the highly concentrated beer made in Kavango and Katima Mulilo can be used to tap into the IK of learners in teaching distillation. These topics can be taught by an expert from the local indigenous people who could explain the process to the learners. Elderly people in the community have a vast knowledge on this topic and the curriculum could exploit this.

Hays (n.d.) indicated that children learn better when the content of the subject is presented in the language and context that is relevant to them. During the brewing process when the expert explains in the local language, the teacher or a learner who is more knowledgeable than others (Stott, 2016) can explain or translate concepts into English. This way of teaching might engender a sense of pride in their IK and they could become adept at critical thinking by linking every topic in science to what they know from home.

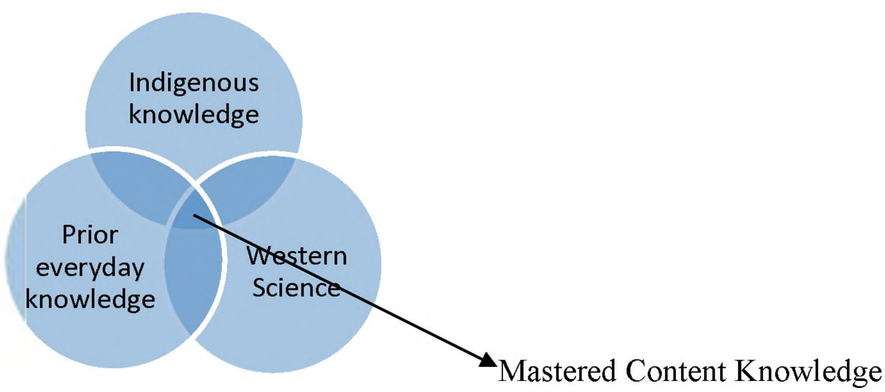
Relying on rote learning does not allow the teacher to use or connect what the learners know to their PEK and IK. When learners lack the necessary PEK and IK needed for linking with the knowledge acquired in lessons, it becomes difficult for them to construct new knowledge and may hamper their success in learning that lesson. Accordingly, it is the responsibility of the teacher to prepare learners for learning new concepts (Buarapha, Singh, & Roadrangka, 2006).

IK is not only applicable to Physical Science but also to other science subjects such as Life Science and Agriculture (Mapara, 2009; Odora-Hoppers, 2001). For example, Agriculture is an obvious area (Ogunniyi & Ogawa, 2009) where there is a huge body of effective indigenous practices and knowledge. Before attending school, most African learners have accumulated a wealth of holistic knowledge about their environment (classification of plants and animals, weather conditions, soil types, seasonal changes, tracking game, various methods of conservation, finding water sources, curing diseases) which school science with its compartmentalized disciplines have tended to displace rather than accommodate (ibid).

Based on my experience as a Physical Science teacher, I have discovered that learners often grasp new subject knowledge more easily if there is an IK foundation anchored to the topic they are learning. When IK of the indigenous people is integrated into the lessons, the aim is for the learners to master the subject content by using hands-on, minds-on and words-on strategies (Maselwa & Ngcoza, 2003).

2.7 Mastering of Content Knowledge in Physical Science lessons

Learning can be the result of the interweaving of the IK, PEK and lesson content knowledge in the science lesson. The diagram below attempts to show what happens during the lesson when PEK, IK and western science (WS) are included in one lesson. The section where the three are interwoven is called Mastered Content Knowledge. Not everything that we teach during the lesson is grasped by the learners for future retrieval during examinations. For the learners to master the content, teachers need to build from what the learners already know and make the connection between WS, PEK and IK.



Adopted from Mukwambo, Ngcoza and Chikunda (2014, p. 3)

Mastering of the content requires teachers to use the IK, PEK and WS to help learners become proficient. The three circles represent the different types of knowledge that learners have; or the different knowledge zones in the mind of the learner. The sections where the circles intersect, represents the knowledge that matched and the zone outside represents the knowledge that does not have a link to either of the three. The fourth zone where all three circles intersect, represents the mastered content during the lessons.

Mukwambo (2013) indicates that although prior everyday knowledge and experiences have been sanctioned as sources of knowledge, little has been done to incorporate them into the actual teaching and learning of science. Furthermore, for learning to happen, learners need to have a base foundation to be able to connect the knowledge learned to their IK and PK. Indigenous Knowledge, Prior Knowledge and Lesson Content Knowledge are interwoven and cannot be separated, but the teacher needs to re-connect the content to the IK of the learners in the science classroom. Mukwambo, et al. (2014) argued that learning becomes effectives when participants' cultural resources are harnessed in the teaching and learning of science subjects.

Moreover, when learners come into contact with western science concepts, a link occurs to their existing knowledge but first they must make meaning from the concepts in the local language before being translated back into the LoLT. For non-western learners, the interaction between two worldviews, IK versus Western Science, characterizes much of their school experiences, complicating the learning process and potentially resulting in cognitive conflict called cognitive dissonance/perturbation (Le Grange, 2007). The diagram above illustrates how the two worldviews conflict in the mind of a non-western learner and when it results as learned content. It is crucial for the teachers working in these contexts to be aware of this interaction and understand the way it could complicate the learning process. Effective learning will depend on teachers' understanding of this interaction and their ability to manage classroom discourses to reduce the conflicts (ibid). Every new word introduced to the learners will bring about conflict. The solution to this encounter could be resolved by introducing Jegede's (1995) theory of collateral learning.

Jegede's (1995) theory of collateral learning identifies the four types of collateral learning as: parallel, simultaneous, dependent and secured. For the learners not to have dissonance/perturbation teachers need to incorporate all four collateral learning strategies in their teaching and know exactly what is happening to the learners.

- Parallel collateral learning occurs when learners acquire and maintain opposing schemata about concepts and ideas in their long-term memory when learning new science concepts;

- Simultaneous collateral learning occurs when the concept needs to be embedded in the long term memory of the learner, the information needs to be processed over a long period of time;
- Dependent collateral learning occurs when schemata from one worldview are presented which challenge those of another worldview enabling the learner to modify existing schemata; and
- Secured collateral learning occurs when learners acquire knowledge or an intellectual skill as a gradual and incremental process rather than a single event. Learners have to resolve what he/she might experiences as cognitive conflict or mental dissonance in the knowledge base embedded in his/her long-term memory (Le Grange, 2007).

Using collateral learning helps the teacher to integrate PEK, IK and WS into the science lesson. This points to the uses of learners' indigenous knowledge as underpinned by socio-cultural theory. In the next section, I discuss the theoretical framework that informed my study and which was used as a lens to understand my data.

2.8 Theoretical framework

This study is informed by Vygotsky's (1978) socio-cultural theory. To Vygotsky, this perspective recognizes that culture and beliefs influence the way learners learn. This knowledge if consciously brought to class has the potential to enable meaningful learning of concepts. I now discuss this in detail.

Socio-cultural perspective

Socio-cultural theory approaches to learning and development were first systematized and applied by Vygotsky and his collaborators in Russia in the 1920s and 1930s. Vygotsky (1978) asserts that human learning presupposes a specific social nature and a process by which children grow into the intellectual life of those around them. Socio-cultural theory is founded on the premise that learning is socio in nature and that language plays a key role in learning interactions and learning itself. While producing language, students use and learn language as a mediator between them and others to understand (Allahyar & Nazari, 2012). Teachers' perceptions of learners and learning are one of the most critical and decisive factors in the teaching and learning process, and more clearly in constructing teaching (ibid).

Culture plays a vital role in how we construct knowledge and it influences the way knowledge is constructed. Language as embedded in culture is a mediational tool used to acquire knowledge. Furthermore, mediation is the key in this approach to understand how human mental functioning is tied to cultural, institutional, and historical settings since these settings shape and provide the cultural tools that are mastered by individuals to form this functioning (John-Steiner & Mahn, 1996). Language plays the pivotal role in constructing knowledge in a socio-cultural perspective. Research indicates that language is placed at the central position of knowledge construction and acquisition (ibid). Learners construct knowledge in the language that is known to them and this language is embedded in the society where the learner is coming from. Teachers use language as a tool to connect the IK of learners with western science, however, not all western science terminology exists is in our indigenous language (Shizha, 2007). So, teachers have to find the way to scaffold the language of learners to meet the western language requirements in science by closing the gap between indigenous science and western science.

Allahyar and Nazari (2012) agree with Willis (2009) by indicating that the socio-cultural view of learning shifts the teacher's focus from individual internalizing learning, an acquisition metaphor of learning, to a more participative perspective. So, the unit of analysis becomes not the individual teacher or student, but the patterned collective doings (ibid).

Moreover, socio-cultural theory rests on the premise that learning is social, and that it is through social interaction with teachers and peers who are more knowledgeable that learners receive the assistance needed in their zone of proximal development (ZPD) to engage in culturally meaningful tasks (Stott, 2016; Teemant, 2005). Learning can only take place when there is interaction between peers from different levels of the ZPD. Furthermore, Vygotsky (1978) points out that social interactions play a critical role in cognitive development in relation to what is learned and when and how learning occurs. Without learning that occurs as a result of social interaction, without self-awareness or use of signs and symbols that allow us to think in more complex ways, we would remain slaves of the situation, responding directly to the environment (Lutz & Huitt, 2004).

Vygotsky believes that human activity happens in a relationship where those whose actions are the focus of analysis (subjects) resolve a shared problem which is their 'focus of learning' (object) by using 'mediating means' (tools) to achieve a goal (Martin, 2008). Vygotsky's theory suggests that we learn first through person-person interaction and then as individuals through an internalization process that leads to deep understanding (Blake & Pope, 2008). This interaction happens in the environment where the learners live and are surrounded by people of higher cognition or schema. Learning is the result when learners interact with more knowledgeable other (MKO) in their societies and at school. Vygotsky (1978) proposed that learning awakens a variety of internal development processes that are able to operate only when the child is interacting with people in his environment and with his peers (Palincsar, 1998).

The socio-cultural perspective helped me to analyze the data generated from the semi-structured interviews, questionnaires and observation by integrating the experiences of teachers' views and pedagogical strategies on how knowledge gained by the learners at home, community or environment could be useful. Furthermore, the socio-cultural perspective allowed me to bring the two together, (home and the school), and how they could work hand-in-hand to allow the learners to learn. With the view that knowledge is context imbedded and context can help learners learn. Lastly, the socio-cultural perspective helped me to be able to see how the school and environment (home and community) were interwoven and depended on each other.

2.9 Concluding remarks

In this chapter, I discussed the relevant literature that supported my research. I looked at learner-centred education (LCE) in the Namibian context and the role of teachers and learners in LCE. I looked at the conceptual framework that informed my study and also at the role of the teacher. Under the conceptual framework I focused on Prior Everyday Knowledge and Indigenous Knowledge. Lastly, I discussed the theoretical framework by looking at socio-cultural theory. This clarified my research by triangulating different theories.

Chapter Three focuses on describing and justifying the methodological framework and research techniques used in my research.

CHAPTER THREE

RESEARCH METHODOLOGY

> *Case study methodology has long been a contested terrain in social science research which is characterized by varying, sometimes opposing, approaches espoused by many research methodologists. Despite being one of the most frequently used qualitative research methodologies in educational research, the methodologists do not have a full consensus on the design and implementation of case study, which hampers its full evolution (Yazan, 2015, p. 134).*

3.1 Introduction

In this chapter I describe the methodological frameworks that underpin the research process in this study. I decided on a mixed method design that allowed for both qualitative and quantitative data collection and analysis but using a case study as my primary research method. I discuss the techniques that I used to collect data to answer my research questions. This study employed the following data gathering techniques, namely, questionnaires and semi-structured interviews. The sampling strategies, data analysis, validity and trustworthiness, and ethical considerations pertaining to the study are considered in this chapter. The chapter ends with some concluding remarks.

3.2 Research paradigm

The concept of a 'paradigm' refers to the way we view and think about the world, our beliefs and how we arrive at conclusions about the phenomena in a research project (Guba & Lincoln, 1994). It can be influenced by the nature and the context where the researcher is located. Guba and Lincoln (1994) further explain that a paradigm entails the basic beliefs system or *worldview* that guides the investigator (researcher), not only in choices of method but in ontologically and epistemologically fundamental ways. Lending support, Huitt (2011) posits that a paradigm is the basic way of perceiving, thinking, valuing, and doing associated with a particular vision of reality. He further indicates that it is a constellation of concepts, values, perception and practices shared by a community, which forms a particular vision of reality that is the basis of the way a community organizes itself. To Huitt (2011), a *worldview* is a coherent collection of concepts and theorems that must allow us to construct a global image of the world and in this way to understand as many elements of our experiences as possible.

This study is further underpinned by the interpretive paradigm based on the views, experiences and pedagogical strategies of Grade 9 Physical Science teachers on the inclusion of IK in their science lessons. In the next section I discuss the interpretive research paradigm.

3.3 Interpretive paradigm

According to Henning, Van Rensburg and Smit (2007), an interpretive paradigm does not concern itself with the search for broadly applicable laws and rules, but rather seeks to produce descriptive analysis that emphasizes deep, interpretive understanding of social phenomena. This study is underpinned by an interpretive research paradigm that describes the real phenomena surrounding my research questions. The interpretive paradigm is also known as a humanistic, constructivist, naturalistic, anti-positivist and alternative paradigm of research (Hussain, Elyas & Nasseef, 2013).

This resonates with Taylor and Medina (2013) who posit that the humanistic paradigm arrived in education research during the late 1970s, influenced strongly by anthropology which aims to understand other cultures from the inside. That is, to understand the culturally different ‘other’ by learning to stand in their shoes, look through their eyes and feel their pleasure and pain. I chose an interpretive paradigm because I had hoped that it would enable me to understand the phenomena surrounding my research participants and interpret the data collected meaningfully.
According to Wahyuni (2012),

> Interpretivist researchers believe that reality is constructed by social actors and people’s perceptions of it. They recognize that individuals with their own varied backgrounds, assumptions and experience contribute to the on-going construction of reality existing in their broader social context through social interaction. Interpretive researchers favour to interact and to have a dialogue with the participants. (p. 71)

In the context of this study, an interpretive paradigm enabled better interaction with the participants during the data gathering process. Moreover, knowing the background culture of the research participants gave me insight and access which allowed me to collect more detailed data.

Additionally, Hussain, et al. (2013, p. 2375) assert that “interpretive research seeks to understand values, beliefs and meaning of social phenomena and they extract knowledge or an empathetic understanding of human social activities and experience". Through using an interpretive paradigm, I worked closely with my participants on their views and experiences on the inclusion of IK in their lessons. Thus, within the interpretive paradigm, I employed a case study approach.

3.4 Case study

A case study is a popular approach that allows researchers to develop and present an in-depth view of a particular situation, event and entity (Rule & John, 2011). Cohen, Manion, and Morrison (2011, p. 253) define case study as "a specific instance that is frequently designed to illustrate more general principles". A case study approach was appropriate in this study as it allowed me to focus on the specific objective rather than looking at a broad picture that can be solved within the given time. To this end, Gay, Mills, and Airasian (2011) define a case study as a "qualitative research approach in which researchers focus on a unit of study known as a bounded system" (p. 444).

Baxter and Jack (2008) argue that a qualitative case study is an approach to research that facilitates exploration of a phenomenon within its context using a variety of data sources. This ensures that the issue is not explored through one lens, but rather a variety of lenses and that allows for multiple facets of the phenomenon to be revealed and understood (ibid). On the other hand, Harwell (n.d.) asserts that quantitative research methods attempt to maximize objectivity, replicability and generalizability of findings and are typically interested in prediction. My research has both qualitative and quantitative data and I focused on teachers' views and experiences on the inclusion of IK in their science lessons as well as the pedagogical strategies that they use when mediating learning of science as my unit of analysis.

According to Fidel (1984), a case study is a detailed analysis of an individual case supposing that one can properly acquire knowledge of the phenomenon from the intensive exploration of a single case. I opted for a case study for my research because it developed new understanding on how local knowledge could be included in science lessons to aid learners' understanding.

As a research strategy, the case study was an appropriate method for my study because it allowed me to study the phenomena surrounding the inclusion of IK in Physical Science lessons, thus it contributed to new knowledge. The case study is used in many situations to contribute to our knowledge of an individual, group, and organization, social, political, and related phenomena (Gay, et al., 2011; Yin, 2003). This indicates that case studies are useful when describing the context of the study and the extent to which a particular program or innovation has been implemented. It should be recognized, however, that case studies have both shortcomings and strengths.

For instance, Cohen, et al. (2011) looked at the possible advantages of the case study. Case study presents research or evaluation data in a more publicly accessible form than other kinds of research reports. It also recognizes the complexity and 'embeddedness' of social truth. Case studies allow generalization either about an instance or from an instance to a class. Case study research is unique in that it leads to different kinds of knowledge compared to other kinds of research (Gay, et al. 2011). Johansson (2003, p. 2) asserts that a case study is expected to capture the complexity of a single case, and the methodology which enables this has developed within the social sciences. This study focused on Grade 9 Physical Science teachers' views and experiences on the inclusion of indigenous knowledge in their science classrooms. The case study is the most flexible of all research designs, allowing the researcher to retain the holistic characteristic of real-life events while investigating empirical events (Schell, 1992).

Gay, et al. (2011) described a case study as *particularistic*, *descriptive* and *heuristic*. Particularistic means it focuses on a particular phenomenon, such as a situation or event. Descriptive means that the end result of the case study, the narrative, includes 'thick description' of the phenomenon which was the focus of my case study research. Heuristic refers to the fact that case study illuminates the readers' understanding of the phenomenon under study beyond the readers' original knowledge. This research project met all three descriptions of a case study.

Cohen, et al. (2011) suggested that a case study is very strong on reality. It gives detailed findings on the individual or group of people. In this study, it was undertaken by a single researcher without the need for a full research team. The results are more easily understood by a wide audience as they are frequently written in everyday, non-professional language. It is intelligible, it speaks for itself. Yin (2003) indicates that it relies on multiple sources of evidence, with data needing to converge in a triangulation fashion. In this case, interviews and questionnaires were used to triangulate the data collected.

Notwithstanding, a case study has potential limitations as illustrated by Cohen, et al. (2011). For example, these scholars argue that a case study is not easily open to cross-checking, hence they may be selective, biased, personal and subjective. In the context of my study, this was avoided by member checking and transcribing the interviews and lesson observations word by word. It is also prone to problems of observer's bias, despite attempts made to address reflexivity. It also has a possible bias in data collection and interpretation, since a single person gathers and analyzes the information which could result in the person manipulating the data. The results may be generalizable except where other readers/researchers see their application. However, Yin (2003) argues that the initial study questions may have reflected one orientation, but as the case study proceeds, a different orientation may emerge and the evidence begins to address different questions. Although Yin (2003) claimed such flexibility to be the strength of the case study approach, in fact the largest criticism of the case study is based on these types of shifts. Changing the questions will affect the reliability and outcome of the case study.

3.5 Mixed methods design

In doing research, the researcher can choose the method that he/she wants the research to follow. The research design adopted in this study was mixed methods with a greater focus on qualitative rather than quantitative data. That is, mixed methods research is formally defined as the class of research where the researcher mixes or combines qualitative and quantitative research techniques, methods, approaches, concepts or language into a single study (Harwell, n.d.). The QUAL in uppercase indicates that the mixed methods research will be dominated by QUALITATIVE data and quant in lowercase indicates that quantitative was used to a lesser degree in this research. Qualitative data tends to be open-ended without predetermined responses while quantitative data usually includes close-ended responses such as found in questionnaires (Cresswell, 2014).

According to Joubish, Khurram, Ahmed, Fatima, and Haider (2011), qualitative research is used to gain some insights into people's attitudes, behaviours, value systems, concerns, motivations, aspirations, culture or lifestyles. Furthermore, it is a generic term for investigative methodologies described as ethnographic, naturalistic, anthropological, field, or participant observer research. The data collected in this research were analyzed using QUAL which focuses on interpretive aspects, while quant focuses more on presentation of tables and graphs. Qualitative data are collected from small groups of people through methods, such as observation, interview and documents analysis. In contrast, quantitative research approaches focus on the data for large number of participants and data are collected through methods such as questionnaires or from published statistics and data are analyzed by using statistical techniques (Gable, 1994).

Johnson, Onwuegbuzie and Turner (2007) define mixed methods research as a type of research design in which QUAL and quant approaches are used in types of questions, research methods, data collection and analysis procedures or in inferences. Mixed methods research occurs when a researcher or team of researchers combine(s) elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the broad purposes of breadth and depth of understanding and corroboration (ibid).

In this study, Part A of the questionnaire (see Appendices F & G) established the demographic information of the participants that yielded quantitative data and I adopted this from Ongunniyi (2007a). Part C was more quantitative; whereas Part B consisted of qualitative data where descriptive answers were required. In the context of this study, the use of mixed methods research was also an attempt to legitimate the use of multiple approaches in answering research questions, rather than restricting or constraining researchers' choice (Johnson & Onwuegbuzie, 2004). Lending support to this argument, Johnson, et al. (2007) point out that mixed methods research has advantages over the other forms of research. Firstly, combinations are used for confirmation or corroboration of each other to provide triangulation. Secondly, combinations are used to enable or develop analysis in order to provide richer data. Thirdly, combinations are used to initiate new modes of thinking by attending to paradoxes that emerge from the data sources.

3.6 Research goal and questions

The main goal of this study was to explore Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) and the pedagogical strategies that they use in their lessons. To achieve this goal, the following questions were guided the study:

Research questions:

- What are Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) in their science lessons?
- What kinds of local/traditional knowledge (indigenous knowledge) do Grade 9 Physical Science teachers have/not have when teaching Physical Science topics?
- Where and how do Grade 9 Physical Science teachers use local/traditional knowledge (indigenous knowledge) in their science lessons?
- What factors enable or constrain Grade 9 Physical Science teachers from making use of local/traditional knowledge (indigenous knowledge) in their Physical Science lessons?

3.7 Sample size and sampling techniques

The study was carried out in the Ohangwena Region of Namibia specifically in the Endola education circuit. The area where the study was carried out borders the Oshana Region in the south, Omusati Region in the west and in the north it borders Angola and Ohangwena and Ongha circuit in the east. The circuit consists of 33 schools of which 13 are primary schools catering for Grade 0-7, 16 combined schools with Grade 0-10, one junior secondary school offering Grade 8-10 and three secondary schools with Grade 8-12. This study focused on 20 school teachers teaching grade 9 Physical Science in the circuit. The teachers were chosen based on the location of the school where I am currently teaching. The questionnaires were sent to all 20 teachers in the Endola circuit whereas only two selected teachers were interviewed. The two teachers that I interviewed were teaching Physical Science in Grade 9, I chose these teachers based on the distance from my school to the school where they are teaching.

The criteria I used to choose the participants for the interviews were: The participant must have taught Physical Science for at least two years in the Ohangwena Region. They should be knowledgeable about IK and how it can be incorporated in science lessons. Gender balance was also considered in the selection of the participants so that I could have views from both genders about their views and experiences on the inclusion of IK in Physical Science lessons. So, as proposed by Cohen, Manion, and Morrison (2011) I used purposive sampling when choosing the teachers to interview in this study.

Bertram and Christiansen (2015) distinguish between purposive sampling and convenience sampling by stating that "purposive sampling means that the researcher makes specific choices about which people, group or objects to include in the sample, and convenience sampling means choosing a sample which is easy for the researcher to reach" (p. 61). This concurs with Cohen, et al.'s (2011) description of convenience sampling that it involves choosing the nearest individuals to serve as respondents and continuing that process until the required sample size has been obtained.

Since the research is a qualitative case study, I did qualitative sampling for the interview participants by chosing two teachers teaching at the schools that are rearcheable within 20-30 minutes of driving. Qualitative sampling is the process of selecting a small number of individuals for a study in such a way that the individual chosen will be good key informants who will contribute to the researcher's understanding of a given phenomenon (Gay, et al., 2011). As mentioned earlier, I selected the teachers for the interviews based on distance from my school to their schools.

3.8 Researcher

My role as a researcher during the research was to facilitate the research process. I distributed questionnaires to teachers in Endola circuit. I asked for permission from all the participants before conducting the interviews. For the interview, I chose two teachers, one female teacher and one male teacher. During the interviews I probed for more information from the participants to supplement the questionnaires. In support of this, Henning, et al. (2007) indicate that the interviewer is a neutral facilitator who elicits the forthcoming information from the interviewee and the interviewee gives these responses with the help of questions and prompts in an atmosphere of trust and accountability.

Lastly, I transcribed the interviews and then analyzed the data, and wrote up the research by interpreting the data and presented the findings.

3.9 Data gathering techniques

The following data gathering techniques were used to collect data for my research:

- Questionnaires; and
- Semi-structured interviews.

I used two data gathering techniques for validation purposes, a process known as triangulation (Cohen, et al., 2011). The two techniques were chosen based on the adavantages they have, even though they have some weaknesses but their strengths were considered first. This research is a mixed method design and I needed more numerical data generated from questionnaires that were sent to 20 teachers in the circuit. Part A of the questionnaire was more quantitative, Part B question 11, and Part C question 12 were all looking for quantitative data respectively (see Appendices F & G). The semi-structured interview was used to offset the weaknesses of the questionnaires and also to have the first hand information and probe more information where it was needed, which could not be done with questionnaires. I chose semi-structured interviews to be able to have person-to-person contact and make sense out of something that they could not express in words. More focus was thus on qualitative data obtained from the open-ended questions in the questionnaires and triagulated with the data from semi-structured interviews (see Appendix H).

Table: 3.1 Data gathering techniques

Stages	Methods used to gather data	Document from which data is to be gathered	Purpose of the data
Stage 1	Piloting of questionnaires and interview questions	Piloting was done with four first year BEd Honours students	To find out how accurate my questions were in addressing my research questions
Stage 2	Distribution of questionnaires to Physical Science teachers, teaching Grade 9	Views and experiences of Grade 9 Physical Science teachers on the inclusion of IK in their lessons	To collect data for my research question on views and experiences of teacher on the inclusion of IK in their lessons
Stage 3	Semi-structured interviews with two selected teachers in the circuit	To find out teachers' views and perceptions on the inclusion of IK in their lessons	To find out how teachers in the circuit incorporate IK in their lessons

3.9.1 Questionnaires

The questionnaire is a widely used and useful instrument for collecting survey information, providing structured, often numerical data, being able to be administered without the presence of the researcher and often being comparatively straight forward to analyze (Cohen, et al., 2011).

Lending support, Rule and John (2011) add that questionnaires are prepared sets of field questions to which participants respond on their own not in the presence of the researchers. To this end, Gay, et al. (2011) describe a questionnaire as a written collection of self-report questions to be answered by a selected group of research participants. In this research the selected participants were Grade 9 Physical Science teachers. I chose this technique because it enabled me to collect data from a large number of participants within a short given time.

The advantages of questionnaires are: the questionnaire provides an efficient method of collecting data from a large number of people simultaneously (Rule & John, 2011, p. 66). It is also less expensive compared to other forms of data collection methods. It also eliminates possible bias by the researchers in other methods. It can be administered to a large number of people and it can reach a large group of geographically spread-out respondents within a short time (Bertram & Christiansen, 2015). On the other hand, questionnaires have the following disadvantages:

- The researcher is not always present to check whether a respondent understood the questions or whether the right person actually completed the questionnaire;
- Respondent may not understand the questions asked or may give the answer that they think the researcher wants to hear;
- Questionnaire requires that the respondents are literate, it can only be administered with literate people;
- Low return rate, most often questionnaire are posted by mail; and
- Questionnaire may take too long to be returned (Bertram & Christiansen, 2015)

In this study, 20 questionnaires were sent to teachers and only 10 questionnaires (50%) were returned. It took time to get the questionnaires back as the teachers were busy with their school work and some were not willing to return them and so I had to follow-up via the school principals. The process was very slow; it took me five months (April to August 2016) to get the 10 questionnaires that were then analyzed and used in this research. This affected the time allocated to collecting data and the plan of the research.

To offset the disadvantages and weaknesses of questionnaires in this study, I also used semi-structured interviews.

3.9.2 Semi-structured interviews

An interview has many strengths and limitations during the process of collecting data. The strengths are as follows: the order of the interview may be controlled while still giving space for spontaneity, and the interview can press not only for complete answers but also for responses about complex and deep issues (Cohen, et al., 2011). I chose semi-structured interviews because they allowed me to elicit more information from the participants and also to see how the participants reacted when asked about the inclusion of IK in their lessons. It also allowed me to have eye contact with the participants and observe their facial expressions and actions. Interviews are also suitable for use with both educated (literate) and uneducated (illiterate) people. The other advantage of an interview is that it can provide information that is inaccessible through observation and questionnaires (Gay, et al., 2011).

The limitation of an interview is that it is time consuming to interview each participant. According to Cohen, et al. (2011), interviews may affect the naturalness and relevance of questions and answers.

In this study the interviews were conducted in a conducive environment where teachers were free to express themselves. Firstly, I had to build up a good rapport with the teachers before the interviews so that they felt confident and free to express themselves on the day of the interviews. I visited their schools when making appointments and tried to establish a sense of a community of researchers. The interviews were conducted after school at the school where teachers are teaching, to allow them to be free since they are used to the environment. The male teacher's interview lasted for about one hour, the reason being that he gave more examples (see Appendix I, T_1SSIM) which allowed me to probe him further. On the other hand, the female teacher's interview lasted for about 40 minutes because she was not relaxed and I could sense a language problem when answering her questions (see Appendix I, T_2SSIF). I so wish that I had given these participants an option to be interviewed in their local language as this would resonate very well with my research project in indigenous knowledge.

3.10 Piloting the study

I piloted my questionnaire with four first year BEd (Hons) Science Elective students to check whether the questions I had asked addressed my research questions. Furthermore, the piloting helped me to modify the questions so that they were unambiguous. Similarly, to validate the semi-structured interview questions I gave them to four master's students doing Science Education to read through and make any necessary adjustments.

3.11 Validity and trustworthiness of my research

Validation is the process of making sure that the data collected are trustworthy (Long & Johnson, 2000). Golafshani (2003) points out that validity determines whether the research truly measures what it was intended to measure or how trustworthy the research results are. In support of this, Gay, et al. (2011) assert that validity is the degree to which qualitative data accurately gauges what we are trying to measure. Validating data helped me to assure the reliability of my research when interpreting the data gathered during the process of data narrative and discussion techniques.

To establish the 'trustworthiness of the research', Creswell (2014) uses unique terms, such as credibility, authenticity, transferability, dependability, and conformability as the naturalists equivalents for internal validation, external validation, reliability and objectivity. The trustworthiness of my research was thus evaluated by using, *triangulation*, *validity* and *reliability* as discussed below in more detail. The questionnaires were validated with 10 masters' students to ensure they were clear-cut. Questions were discussed and corrections were made to some of the questions to align them with my research questions. For quantitative data the focus was to control all the components in the actions and presentations of the participants – the variables were controlled and the research was guided by a cute focus on how variables were related (Henning, et al., 2007).

3.11.1 Triangulation

Triangulation was one of the steps I took to check for the trustworthiness of my data. According to Yeasmin and Rahman (2012), triangulation is a process of verification that increases validity by incorporating several viewpoints and methods. Triangulation provides an important way of ensuring the validity of research, normally data collection methods are triangulated (Johansson, 2003, p. 8). According to Cohen, et al. (2011, p. 195),

Triangulation is a powerful way of demonstrating concurrent validity of a qualitative

> research. Triangulation may be defined as the use of two or more methods of data collection in the study of some aspect of human behaviour.

This research used different data gathering techniques that ensured the validity and reliability through triangulation. Yazan (2015) argues that a case study researcher needs to guarantee construct validity (through the triangulation of multiple sources of evidence, chains of evidence, and member checking), internal validity (through the use of established analytic techniques such as pattern matching), external validity (through analytic generalization), and reliability (through case study protocols and databases).

In this research I used two types of research triangulation as attributed by (Guion, 2002; Hussein, 2009; Olsen, 2004; Yeasmin & Rahman, 2012) as *data triangulation*, and *methodological triangulation*.

Data triangulation is the most common method of verifying data in social science research. This type of triangulation is the most popular, easiest to implement, and is particularly suited for any research (Guion, 2002). It is the use of multiple data sources in the same research for validation purposes (Hussein, 2009, p. 3). Moreover, Yeasmin and Rahman (2012) assert that data triangulation can only be done when data are available, whether it is data from different sources, different investigators, different theories or different methods.

Methodological triangulation involves the use of multiple qualitative and/or quantitative methods to study the program (Guion, 2002). This allowed my research to triangulate the methods used during data gathering techniques. Hussein (2009) noted that this type of triangulation may occur at the level of research design or data collection. In this research I used questionnaires and interviews to generate the data. This allowed me to triangulate the data from two different data gathering techniques.

In addition, Gay, et al. (2011) posit that qualitative researchers can establish the trustworthiness of their research by addressing the *credibility, transferability, dependability*, and *conformability* of their studies and findings. Trustworthiness of my research depended on the triangulation of the data collected which in turn strengthened the research by combining different research methods in mixed methods research.

3.11.2 Member checking

The transcriptions from the interviews were returned to the teachers to verify if what was recorded was an accurate reflection of what they said. Participants (teachers) may be asked to edit, clarify, elaborate and at times, delete their own words from the narratives (Carlson, 2010). This helped me as a researcher to check for accuracy and to triangulate the data collected.

However, member checking is often a single event that takes place only with the verification of transcripts. Creswell and Miller (2000) assert that with member checking, the validity procedure shifts from the researcher to the participants in a study and also helps to establish credibility in the research. Furthermore, member checking helps to improve the trustworthiness of the research, when the participants check the correctness of the data, participants (teachers) add credibility to the research by having an opportunity to react to both the data and the final narrative (ibid).

3.12 Data analysis

This research used a mixed methods approach with the focus on QUAL research and less focus on quant research in analysing the results obtained from the interviews and questionnaires respectively. Qualitative data analysis seeks to organize and reduce the data gathered into themes, which in turn, can be fed into descriptions, models or theories (Walker & Myrick, 2006). By collecting data from the interviews and questionnaires (open-ended questions), I grouped the data by coding it based on the questions answered. Walker and Myrick (2006) define coding as conceptualizing data by a constant comparison of incident with incident, and incident with concept. After coding the data into categories, I then grouped them into themes by coding similar categories together.

Walker and Myrick (2006) assert that coding in qualitative research is one way of exploring bits of information in the data, and looking for similarities and differences within these bits to categorize them and label the data. To code, data are broken down, compared, and then placed in a category. Similar data are placed in similar categories, and different data create new categories. Coding is an iterative, inductive, yet reductive process that organizes data, from which the researcher can then construct themes, essences, descriptions, and theories (ibid). Cohen, et al. (2011) say that qualitative data analysis involves organizing, accounting for and explaining the data. In short, making sense of data in terms of participants' definitions of the situation, noting patterns, themes, categories and regularities.

Data collected from the interviews and questionnaires were analyzed by using qualitative methods; in this instance data gathered from the views and experiences of teachers on the inclusion of local knowledge in Physical Science lessons. Quantitative data including the demographic information of participants from the questionnaire (questions 10 and 11) were analyzed by tabulating certain frequencies of responses regarding views and experiences of teachers on the inclusion of indigenous knowledge in their lessons. Part C, question 12 on the use of local knowledge from the questionnaires were analyzed using quantitative methods.

I adapted and modified Saldana's (2009) generic model below by populating it with more specific items relating to this study to assist in the analysis of the data. Saldana's generic analytical model points to an approach to planning categories and themes.

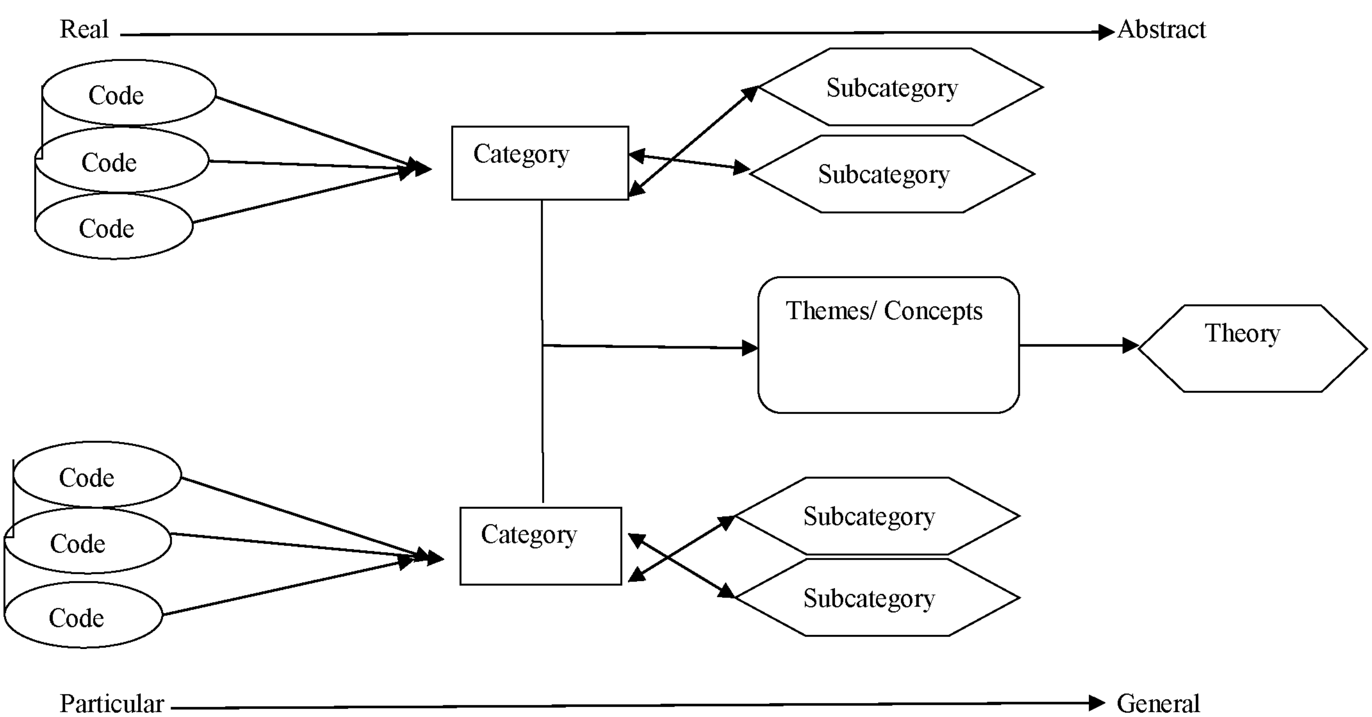


Figure 3. 1: Saldana's (2009, p. 12) theory model for qualitative inquiry

This helped me to group the categories that emerged from the teachers' views and experiences into one group with headings and sub-headings. After coding the category, I came up with the analytical statements from similar categories. The analytical statements were aligned to my research questions. This enabled me to concentrate on one theme at a time.

3.13 Ethical considerations

Before I conducted this study, I wrote a letter to the Director of Education, Ohangwena Education Directorate, and the Inspector of Education for Endola Circuit (see Appendices A & C) to seek permission to carry out my research in schools in the region and circuit respectively. I informed him about my research, the aims and objective of the research and also about the meeting to be held with principals. Principals in Endola circuit were informed on their role during the research which was to deliver the questionnaires to the teachers and return them to me (see Appendix D). Additionally, the aims and the objective of the research were made clear to them. I also wrote a letter to the participants (see Appendix E) to explain the aims and objectives of the research to them. The letter assured the participants that their names were not going to be used in the thesis.

I explained the importance of the interviews to the selected teachers and stressed their right to quit the research if they were not comfortable with the research process. I also explained that the interview would be recorded and their responses would be used in the research. The agreement forms were signed between the interviewer and the participants. Cohen, et al. (2011) indicate that informed consent is the procedure in which individuals choose whether to participate or not in an investigation after being informed of facts that might influence their decision. The agreement forms ensured the participants that their names would be protected by the use of pseudonyms.

Cohen, et al. (2011) indicate that informed consent is particularly important if participants are going to be exposed to any stress, pain, invasion of privacy, or if they are going to lose control over what happens. Furthermore, the principle of informed consent arises from the subject's right to freedom and self-determination. Henning, et al. (2007) state that:

> Guaranteed anonymity is a problem in instances where the theme of the research inevitably means that private matters, such as a mental disease, an addiction problem, fraud, sexual orientation or the termination of a pregnancy, for example, will be directly relatable to the signed consent form, which has a signature of identification. (p. 73)

This would not be the case in the my qualitative case study because it does not involve any of the above mentioned issues, but consent and anonymity agreement must be reached before carrying out the research with participants.

3.14 Limitations of the research

The results of the study were limited to only 10 teachers in Endola circuit; therefore it cannot be generalized for the whole region or country. Only two teachers were interviewed due to time constraints. However, the study provided some invaluable insights on the teachers' views and experiences on the inclusion of traditional or local or indigenous knowledge during their science lessons.

3.15 Concluding remarks

In this chapter, I described the methodological framework I used to gather data for my research. I also looked at the interpretive paradigm which informed my research. I discussed the mixed methods approach used in this study. Furthermore, this chapter outlined in more detail the sampling strategies I used to choose the participants for the interviews. The issue of trustworthiness was ensured by using, triangulation, validity and trustworthiness. Lastly, I looked at the ethical considerations that I had to follow throughout my research.

In the next chapter, I present, analyze and discuss the data generated from my questionnaires and interviews.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION

Analysis is a breaking up, separating, or disassembling of research materials into pieces, parts, elements, or units. With facts broken down into manageable pieces, the researcher sorts and sifts them, searching for types, classes, sequences, processes, patterns or wholes (Jorgensen, 1989, p. 107).

4.1 Introduction

In the preceding chapter, I discussed the methodology I employed in this study and described how data were generated to answer the research goal and questions of this study. To develop an understanding of how Grade 9 Physical Science teachers include local or traditional knowledge or indigenous knowledge during their lessons, as referred to on pages 7 and 37, the following research questions were asked:

- What are Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) in their science lessons?
- What kinds of local/traditional knowledge (indigenous knowledge) do Grade 9 Physical Science teachers have/not have when teaching Physical Science topics?
- Where and how do Grade 9 Physical Science teachers use local/traditional knowledge (indigenous knowledge) in their science lessons?
- What factors enable or constrain Grade 9 Physical Science teachers to make use of local/traditional knowledge (indigenous knowledge) in their Physical Science lessons?

In this chapter, I thus present, analyse and discuss the data generated from the questionnaires received from Physical Science teachers teaching Grade 9. I also present, analyze and discuss the data generated from the semi-structured interviews that I conducted with two Grade 9 Physical Science teachers.

I begin the chapter with the presentation of the teachers' profiles, that is, where they teach as well as their gender, ethnicity, teaching experiences, qualifications and age groups. The questions that were asked in the questionnaire and semi-structured interviews, were almost the some to allow me to collect the some data. This was done to validate the data generated from these two data generation techniques.

4.2 Quantitative data presentation

Ten teachers answered the questionnaire and each teacher was given a code that was used throughout this thesis. For example, questionnaires were numbered from 1-10 and thereafter coded as teacher 1 questionnaire 1 female (T_1Q_1F), T_7Q_7M and so on. I also highlighted the gender of each participant (M or F) and the interviews were coded (teacher 1 semi-structured interview male) T_1SSIM and T_2SSIF.

The quantitative questions that were analyzed included the demographic information of participants in Question 7(a) and (c), Question 11 that required the participants to indicate on a scale of strongly agree, agree, not sure, disagree and strongly disagree their views on the inclusion of IK and Question 12 where they were required to rank the instructional methods for integrating science and indigenous knowledge from the most critical to least critical by choosing only six methods.

4.2.1 Demographic information of the participants

This research was conducted in Endola circuit, one of the nine (9) circuits in the Ohangwena region. Each circuit is headed by an Inspector of Education. Questionnaires were sent to 20 teachers from 20 different schools in the circuit but only 10 teachers (50%) returned them. Bertram and Christiansen (2015) showed that questionnaires have a low return rate, most especially questionnaire that are posted by mail.

Table 4.1: Teachers' demographic information

Demographic information	Codes for teachers	Frequency
Urban school	None	0
Rural school	T1Q1F, T2Q2F, T5Q5F, T7Q7M, T8Q8M, T9Q9M, T10Q7M	7
Semi-urban school	None	0
Semi-rural school	T3Q3F, T4Q4F, T6Q6F	3
Male	T1Q1F, T2Q2F, T3Q3F, T4Q4F, T5Q5F, T6Q6F	6
Female	T7Q7M, T8Q8M, T9Q9M, T10Q10M	4
Kwanyama	T1Q1F, T2Q2F, T3Q3F, T4Q4F, T5Q5F, T6Q6F, T7Q7M, T8Q8M	8
Ndonga	None	0
Herero	None	0
Zambezian	T10Q10M	1
Ngadjera	None	0
Others	T9Q9M	1
ECP	None	0
BETD	T1Q1F, F3Q3F, T7Q7M, T8Q8M, T9Q9M	5
ACE/FDE/MASTEP	T2Q2F, T5Q5F	2
HONS	T4Q4F, T6Q6F, T10Q10	3
MEd	None	0
PHD	None	0
Others	None	0
1-5	T1Q1F, T4Q4F, T9Q9M	3
6-10	T5Q5F, T6Q6F, T8Q8M, T10Q10M	4
11-15	T3Q3F	1
16-20	T2Q2F, T7Q7M	2
20-above	None	0
20-25	T4Q4F	1
26-30	None	0
31-35	T5Q5F, T6Q6F, T8Q8M, T9Q9M, T10Q10M T1Q1F	5
36-40	T3Q3F	1
41-45	T7Q7M	1
46-50	T2Q2F	1
Above 50		1

Of the 10 teachers that returned the questionnaires, seven (7) are located in rural schools (70%) while three (3) teach in semi-rural schools (30%). None of the teachers that took part in this research are from urban or semi-urban areas.

Of the 10 teachers that participated in this research; four (4) (40%) were males and six (6) (60%) were females. Eight (8) teachers indicated that their home language is Oshikwanyama, one (1) speaks Silozi and the other teacher is from another ethnic group not specified on the questionnaire. The qualifications of the teachers range from Basic Education Teachers' Diploma (BETD) to the Bachelor of Honours.

All participating teachers had the minimum qualification required to be a teacher in Namibia. That is, five (5) had BETD as their highest qualification, two had ACE/FDE/MASTEP and two teachers had a Bachelor of Honours. The total teaching experiences of these teachers as well as their experiences of teaching Physical Science ranged from two and half years to 20 years of service. Additionally, the ages of the participants ranged between 20-25 years to above 50 years with the majority of teachers (50%) being between 30-35 years old.

4.2.2 Presentation and discussion of quantitative data

The questionnaires included closed-ended questions. Questions 7, 11 and Part C question 12 were close-ended questions that resulted in the quantitative data.

4.2.2.1 Physical Science teachers' views on the inclusion of IK in their lessons

In exploring whether teachers include IK or not in their lessons, they were asked to indicate 'yes' or 'no' on the use of IK in Physical Science lessons. They were also allowed to give examples of topics in which they included indigenous knowledge. All the teachers (100%) indicated that there is a need to include IK in their science lessons. Teachers were also asked to give the topics in which they had used indigenous knowledge during their Physical Science lessons. Ten topics were mentioned and the number of times each was mentioned are given in the table below.

Table 4.2: Shows the summary of the commonality of the topics where teachers include IK

Topics	Number of teachers mentioning the topic
Combustion	2
Physical and Chemical change	1
Acid and Bases	5
Fermentation	1
Chromatography	1
Pressure	1
Matters	1
Static electricity	2
Friction	1
Density	1
	Total = 16

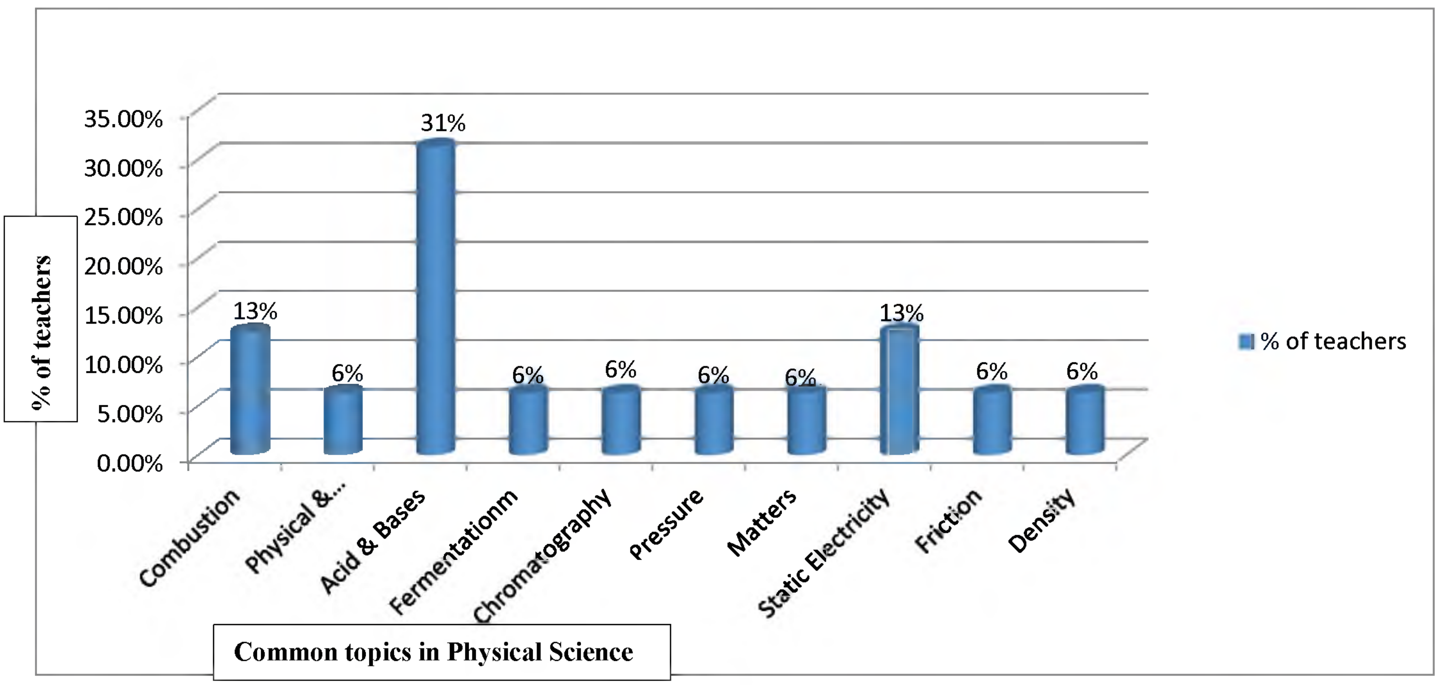


Figure 4.1: Percentage of common topics where IK is included in Physical Science

The results from this graph show that the topic on acid and bases is one of the common topics where IK could easily be included. This represents 31% of the teachers that indicated acid and bases as the common topic where they include IK during their lessons. Combustion and static electricity represent 13% and the rest of the topics were only mentioned once (6%).

4.3 The inclusion of IK in Physical Science Grade 9 lessons

Participants were required to rate how indigenous knowledge should be included in core items of teaching and in relation to the curriculum, syllabus, textbooks, lesson plans, lesson delivery, practical work/activities, tests/examination and general discussion. The findings of this question are presented in the graph below. The graph was separated to make it more visible to the readers

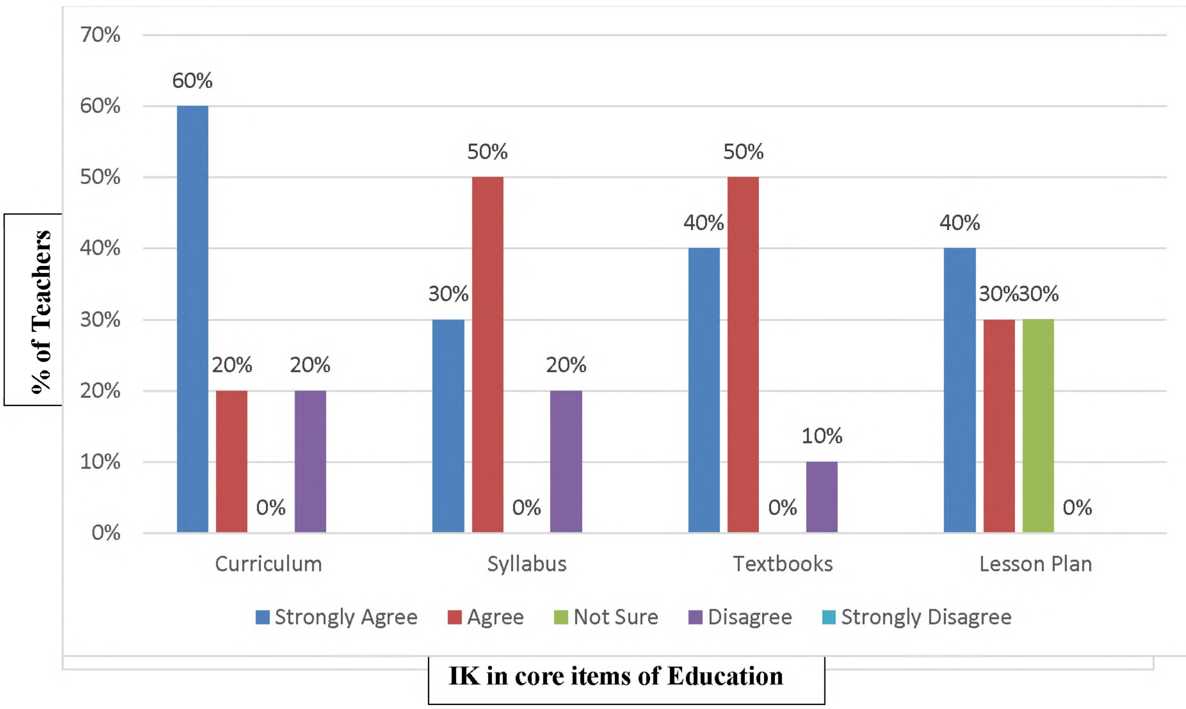


Figure 4.2 (a): Teachers who ranked how indigenous knowledge could be included

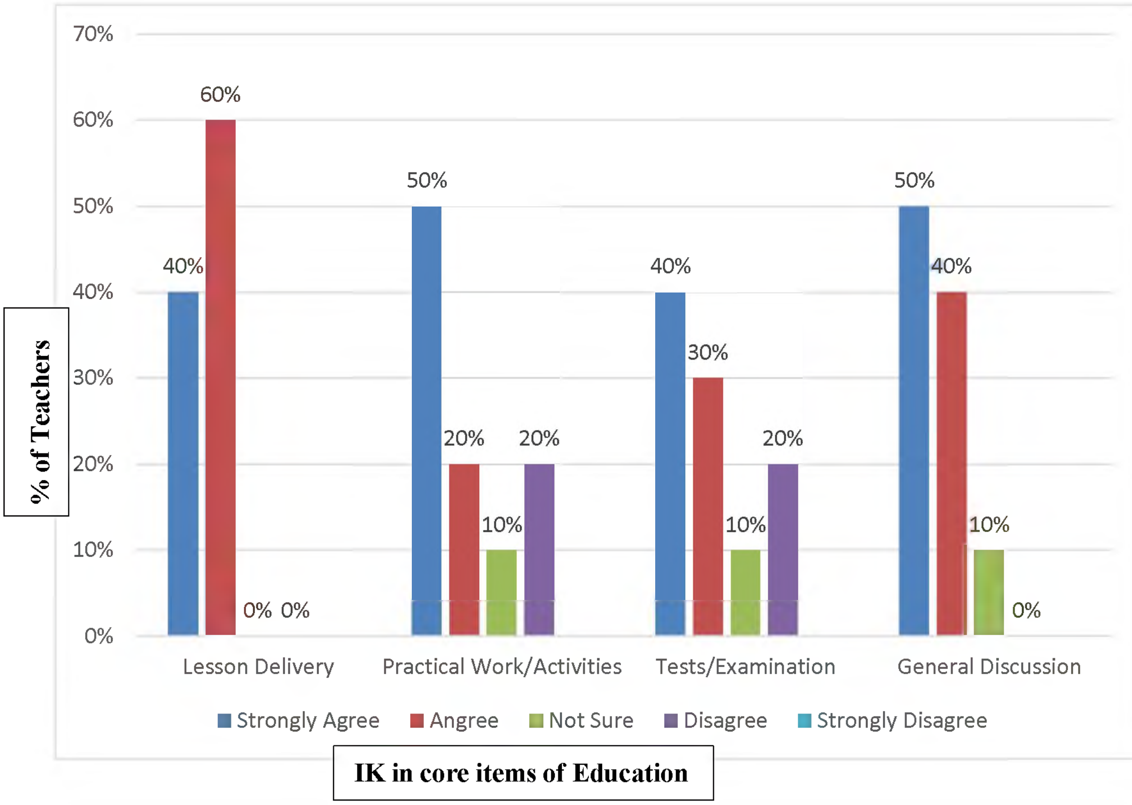


Figure 4.2 (b): Teachers who ranked how indigenous knowledge could be included

All ten (10) teachers who answered the questionnaire ranked how they thought IK could best be included in the core items of education. From the graph, 60% of the teachers strongly agreed and 20% agreed that IK should be part of the curriculum. Only 20% of the teachers disagreed that IK should be part of the curriculum.

The curriculum in Namibia allows teachers to plan their lessons based on the syllabus and each lesson plan must be based on the learning objectives that are found in the syllabus. The syllabus serves as a guide to the teachers on what topics to teach because not all topics in the textbooks are taught at a specific grade. Hence, teachers have to study the curriculum and the syllabus very critically in order for them to implement it successfully.

In this study, six (6) of the teachers strongly believe that the curriculum should include IK to facilitate its inclusion in their science lessons. Learner centred education (LCE) suggests that the point of departure in any lesson is always what the learner already knows and can already do, learnt either from the previous grade or from home, to be able to acquire and relate information taught to what they already know (Namibia. ME, 2010).

Nyambe and Wilmot (2012) outlined that one of the goals of LCE is to encourage teachers to build learning from the prior everyday knowledge or IK of learners. Namibia. MBEC (1996) also emphasises that schools have a special responsibility to use the curriculum together with the syllabus to identify locally relevant content within a common framework so that learners experience their education as being meaningful for them.

The findings indicate that teachers are aware of every statement in the curriculum. However, 40% of the teachers could not answer this question and 60% of the respondents answered the question by giving the statements that appear in the curriculum. One participant wrote *"we need to give everyday examples to specific topics or give examples from our daily life situation"* (T_1Q_1F). This informs the teacher that IK needs to be included in specific topics where examples are available in the community. The other three participants responded that practical activities, investigation and life experiences of learners allows one to use traditional knowledge or local knowledge (T_5Q_5F, T_6Q_6F & $T_{10}Q_{10}M$). One of the participants answered that *"yes, acid identify and name examples of acid in everyday life, discuss that acids are common in foods, particularly fruits and that they have a sour taste"* (T_7Q_7M).

According to Webb (2013), IK should be included in the science curriculum to highlight the relationship between science and culture, for example, what people of other cultures do to cure illnesses without the use of western medicines. In South Africa the inclusion of indigenous knowledge in the curriculum is a positive step and could provide opportunities for debate on interactions between Western and indigenous worldviews (Le Grange, 2007). However, effective learning will depend on teachers' understanding of this interaction and their ability to manage classroom discourses related to this matter (ibid).

Regarding the syllabus which forms the core function of teaching and learning, three teachers strongly agreed (30%) and five teachers agreed (50%) that IK should form part of the syllabus to be taught in schools in Namibia. Two teachers disagreed and said IK did not belong in the syllabus. It was interesting to learn that 90% of the teachers strongly agreed and agreed that IK should be included in the textbooks in order to guide them on what to teach and provide a common understanding of what IK should be included. Only one teacher was opposed to the inclusion of IK in the textbooks.

The syllabus is a document that every teacher needs to refer to in order to be able to teach what is required by the curriculum. The syllabus guides the teacher on the basic competencies to be covered in a grade every year in a specific subject. The finding shows that 30% of the teachers strongly agree that IK should form part of the syllabus, while 50% agree that IK should constituent part of the syllabus. However, only 20% of teachers disagree that IK be the part of the classroom discourse.

The data from the interviews agrees with the data from the questionnaire. For instance, T_2SSIF responded during the interviews that the "*syllabus allows teachers to start from what the learners knows from their locality, community and environment and link them to what was happening in the classroom*". In support of this, T_1SSIM clarified that:

> *"I will say yes, you know it's not specified but some topic or objectives you find that the objective states that you explain so what using examples from everyday life, when they say everyday life we already including the local knowledge, yes, because when they are saying using everyday life situation that when you have to look in the surrounding what is happening, is there anything that I can use to make this learners understand the things that am teaching, so the syllabus has stated that, that any one need to use this (local knowledge)"* (T_1SSIM).

I believe that indigenous knowledge, if used in the classroom in the right way would help learners to achieve a better understanding of the subject content. Maselwa (2004) argues that for the teachers to be able to incorporate IK into their lesson, they need to be knowledgeable about the subject content knowledge and mindful of the elicitation and incorporation of learners' prior everyday knowledge into their teaching and learning.

Pertaining to lesson plans, 40% of the teachers strongly agreed and 30% agreed that teachers should plan their lesson based on the IK of learners. However, 30% of the teachers were not sure whether to agree or disagree. Regarding lesson delivery, all teachers (100%) agreed that IK should form part of the lessons to aid the learners' understanding. Additionally, IK needs to be part of the tests/examinations as proposed by six teachers (60%) involved in this study.

Four teachers (40%) strongly agree that IK should be included in the textbooks that are used as resources in Namibian schools and 50% agree. Only 10% representing 1 teacher disagreed that IK should not form part of the textbooks used in schools in Namibia.

One teacher was more critical on the issue of whether textbooks should include IK instead of the teacher incorporating IK not explicitly explained in the textbooks. The participant wrote *"the books should be written with the inclusion of local indigenous knowledge to have the uniformity on which local knowledge to be included and examined in the examination"* ($T_{10}Q_{10}M$). Instead of the textbook being a useful resource in Namibia, it can become a deterrent when it does not integrate the IK of indigenous people. Textbooks can be a hindrance to the successful integration of indigenous knowledge because they document 'facts' and 'truths' (Shizha, 2007).

The research revealed that the IK of learners needs to be included in the classroom in order to help the learners achieve a better understanding of the topic to be taught. All the teachers (100%) indicated that they do include indigenous knowledge in their science lessons (see Figure 4.1). It is recognized, however, that this can only be achieved when the curriculum allows teachers to do so. I presented the curriculum, syllabus and textbooks as the crucial events in teaching and learning while lesson plans, lesson delivery, practical work/activities, tests/examination and general discussion are embedded in these.

4.4 Instructional methods for integrating science and indigenous knowledge

Teachers were given instructional methods that could link science and IK in the classroom. Out of 12 instructional methods given, participants were allowed to choose six and rank them from one to six, with one the most critical and six the least critical. The table below shows the rankings and points given to each scale given for example, rank 1 = 6 points, 2= 5 points, 3= 4 points, 4 = 3 points, 5= 2 points and 6 = 1 point. The points were then calculated and presented on the bar graph that will be analyzed.

Table 4.3: The table below illustrates the summary after analyzing the data obtained from the questionnaire

Item	Instructional methods for integrating science and indigenous knowledge	Top six	Rank	Total points
11.1	Using a holistic or an integrated instructional approach.	6	6,5,2,4,6,3	16
11.2	Using as many concrete materials to illustrate concepts or principles as possible.	10	3,5,4,5,3,6,5,2,1,2	34
11.3	Emphasizing 'showing' or modeling rather than lecturing.	9	4,3,6,6,4,3,2,3,4	28
11.4	Involving learners actively in problem-solving activities.	8	2,3,1,5,6,5,3,5	26
11.5	Starting lessons with learners' ideas before presenting the scientific view.	9	1,1,2,2,2,3,1,2,1	48
11.6	Extending science classroom discussions to include the IK modes of inquiry, e.g. inviting IK experts into class to present on some topics.	5	1,1,1,4,6	22
11.7	Clarify that indigenous knowledge can co-exist with science that it should not be replaced by it, and has not been replaced by it.	3	5,1,6	9
11.8	Assess each knowledge claim with its own assumptions and standards rather than using science to judge indigenous knowledge as true or false.	3	6,4,6	5
11.9	Teach science using ways that are also used to teach indigenous knowledge e.g. informal conversation and learning through observation and imitation.	1	4	3
11.10	Making lessons learner oriented rather than information oriented.	1	3	4
11.11	Emphasizing cooperative learning rather than competitive leaning.	1	5	2
11.12	Provide learners ample opportunities to investigate and present their findings.	4	2,5,4,4	13

I used the total points for each method on the graph below in order to analyze the data.

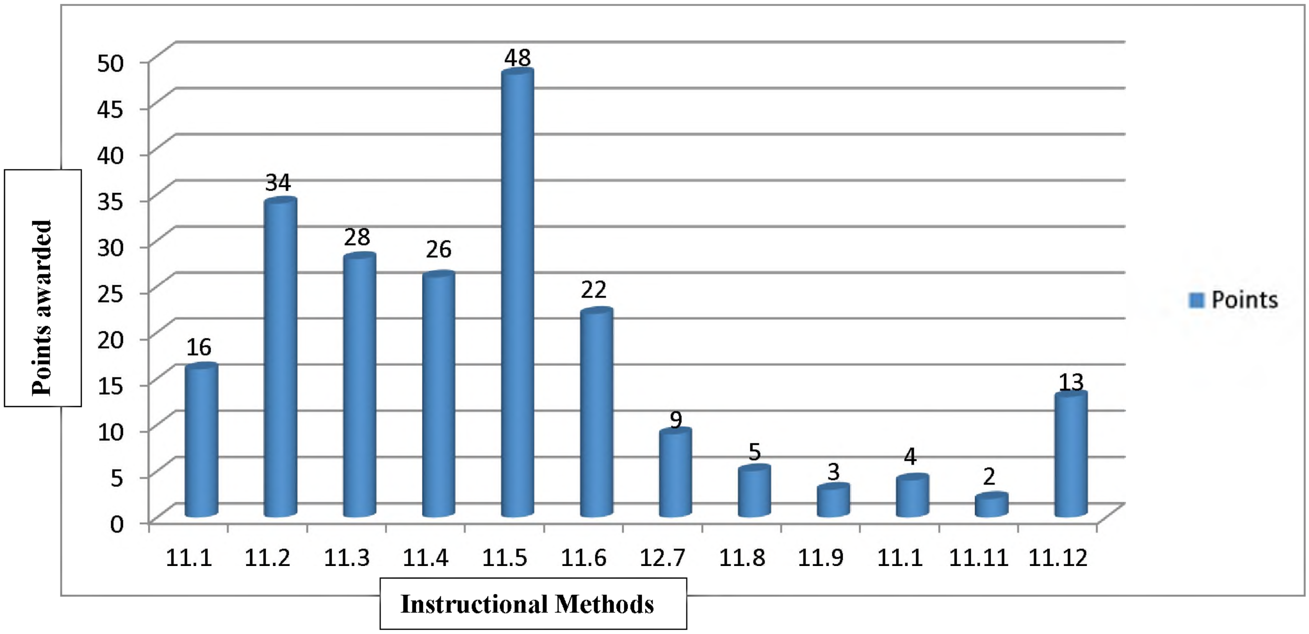


Figure 4.3: Total points awarded to each instructional method

The results show that most teachers prefer to start their lessons by eliciting learners' ideas before presenting the scientific view. I understand that learners' ideas referred to here was their prior everyday knowledge (Kuhlane, 2011) or the local knowledge of learners gained through their interaction with the community or elderly people. Using the scale above, 48 points were accorded to this method which reflected that teachers regard starting with the prior everyday knowledge of learners as the most crucial method. The participants showed that using concrete materials in science lessons to illustrate concepts or principles scored 34 points which scored it as the second most crucial method. The least was to emphasize cooperative learning rather than competitive learning which scored only 2 points from one participant who rank it at 5.

The participants in this study indicated that it is important to start a lessor by using the prior everyday knowledge of learners before the scientific concepts are introduced. This was awarded 48 points out a total of 60 points. Roschelle (1995) argues that prior knowledge helps learners to make the most of the new experience (classroom content) and teachers need to understand how prior everyday knowledge affects learning in the classroom if not used in the correct way. The findings in this research show that teachers are aware that starting from what the learners know can help them achieve the competencies of the lesson. This confirms the fact that prior everyday knowledge is essential to learning (Roschelle, 1995) and is an important prerequisite for individual learners to construct knowledge and learning outcomes (Erlt & Mandl, n.d.).

Otero and Nathan (2004) deduced that teaching science also depends on the teachers' understanding of the continuity and connections within the content area. Without this understanding, teachers will not be able elicit or build from the prior everyday knowledge of learners. This understanding goes together with the teaching experiences that the teacher has in the classroom. Of the teaching experience of the teachers who took part in this study, 70% had been teaching Physical Science between 6-20 years and only 30% of the teachers range between 1-5 years teaching experience (Section 4.2.1). Of the nine teachers who ranked starting lessons with learners' ideas before presenting the scientific view as the most critical method had teaching experience of between 1-3 years.

4.5 Qualitative data from questionnaires and interviews

The qualitative data presented here were generated from the questionnaires and semi-structured interviews (see Sections 3.11.1 and 3. 11.2). In this study, 10 teachers took part in answering the questionnaires and two teachers were interviewed. All the qualitative data from the 10 questionnaires were collated and triangulated together with two interview transcripts and these were analyzed to reveal the emergent themes from the data.

4.5.1 Teachers' views on the most critical teaching methods

In this section I wanted to investigate why the participants ranked the methods from 1 to 6. The data revealed that ranking the methods from the most critical to the least critical was based on their understanding of how they viewed the inclusion of IK in science lessons. One participant indicated that:

> *"Some of the IK needs to be understood by the learners mainly through practice and seeing the results. The learners need to carry out experiments to prove some of the IK (for those that can be tried) and learners should be able to present their ideas of what they know about the IK"* (T_4Q_4F).

This participant favored the inclusion of IK by doing experiments and starting from what the learners know from home. T_2Q_2F explained her choice as:

> *"By using concrete materials simple because is available and cheap as well as easy to use and control, it helps learners to participate and decision making because everyone knows how to use indigenous materials learnt it from home".*

Concrete materials from home are related to indigenous knowledge of local people. The data also revealed that using instructional methods that include IK require more time to prepare as reflected by T_1Q_1F who commented that:

> *They are more critical because they need a lot of preparation for example finding models and concrete materials it needs time. The time allocated to the lessons is also limited so it is not easy to extend lessons to include indigenous knowledge in lessons.*

Some participants did not favour the instructional methods that include IK as shown by T_5Q_5F *"they are showing that there is no inclusion of indigenous knowledge during lesson presentation they are reflecting wrong ideas of implementing traditional knowledge during the lesson".*

In conclusion, the data revealed that 6 teachers (60%) preferred the instructional methods where IK did form part of the lesson in order for the learners to achieve greater understanding. However, 40% of the teachers disagree with the instructional methods that require the use of IK of learners.

4.5.2 Teachers' understanding of the term local/indigenous/traditional knowledge

Teachers were asked to share their understanding of the concept local/indigenous/traditional knowledge in the questionnaires and during the interviews. Their answers revealed that all the teachers who were involved in this study are well informed about the terms local/indigenous/traditional knowledge but there were different understandings about the concepts. For instance, one participant defined IK as *"This is the knowledge that is unique to a culture or society around the world, it developed from experience gained over the centuries and adopted to the local culture"* (T_2Q_2M). This resonates with Ogunniyi and Ogawa's (2008) definition that IK stands for an idea or system of thought peculiar to the so-called 'native' of a particular geographical location or socio-cultural environment.

Hansen and Van Fleet (2003) distinguished traditional knowledge as the information that people possess in a given community, based on the experience and adaptation to a local culture and environment, and have developed over time and continue to develop. As the following teacher commented:

> *"Local/traditional knowledge (indigenous) is knowledge you learnt from the area, tribe where you belongs, I could say is the knowledge of our local people ways of living, cultural background, norms, festival and beliefs"* (T_2Q_2F).

In addition, T_6Q_6F defined IK as *"this is all about knowing the norms and morals of one's culture and other background aspects"*. On the other hand, T_4Q_4F commented that *"local/ indigenous/traditional knowledge a knowledge that we learn from our grand-parents"*. Similarly, Mapara (2009) referred to indigenous knowledge as a local knowledge that is unique to a given culture or society.

4.6 Teachers' views and experiences on the inclusion of indigenous knowledge

Teachers were asked to share their views and experiences on the inclusion of local/indigenous/ traditional knowledge in Physical Science Grade 9. Most of the questions in this section in both the questionnaires and semi-structured interviews were answered well by the teachers.

A short explanation of how themes were developed

To generate data for this section, I used questionnaires and interviews. Data from all 10 questionnaires were collated and analyzed together with two interview transcripts. I scrutinized the commonality from these data sets and developed emergent categories, some categories merged to form themes and some did not. I was guided by the characteristics of socio-cultural theory (Vygotsky, 1978; Lemke, 2001) in coming up with my analytical statements. After this process I devised sub-themes that were translated into six analytical statements.

Table 4.4: Shows the analytical framework (data sources, themes, analytical statements and research questions to be answered)

Sub-themes	Analytical statements	Research questions	Data source
Views, experiences and socio-cultural theory	Views and experiences on the inclusion of IK in Physical Science lessons	1	Questionnaire and Semi-structured interviews
Socio-cultural interaction, language	Knowledge is constructed as teachers make sense of their experience on the inclusion of indigenous knowledge	2	Questionnaire and Semi-structured interviews
Social interaction, language and socio-cultural interactions	Social interaction are vital for inclusion of indigenous knowledge in Physical Science	2	Questionnaire and Semi-structured interviews
Local materials, Indigenous knowledge and Prior everyday knowledge, and interaction between teachers and learners	Teachers actively seek meaning in the environment to enhance learners' understanding in different topics in Physical Science	2 & 3	Questionnaire and Semi-structured interviews
Availability of materials, understanding and benefits to the learners	Factors that influence teachers to include or not include indigenous knowledge in the lessons	4	Questionnaire and Semi-structured interviews
Learners prior everyday knowledge, teacher experiences and community participation	Advantages and disadvantages that influence science teachers' views and experiences on the inclusion or not including indigenous knowledge in their daily lessons	4	Questionnaire and Semi-structured interviews

The table below illustrates how the sub-themes were developed that emerged into analytical statements.

Table 4.5: Shows the sub-themes, analytical statements and teachers' codes

Sub-themes	Analytical statements	Teachers' codes
Views, experiences socio-cultural theory	Views and experiences on the inclusion of IK in Physical Science lessons	T1Q1F, T2Q2F, T3Q3F, T4Q4F, T5Q5F, T6Q6F, T7Q7M, T8Q8M, T9Q9M, T10Q10M T1SSIM, T2SSIF
Socio-cultural interaction, language	Knowledge is constructed as teachers make sense of their experience on the inclusion of indigenous knowledge	T1Q1F, T2Q2F, T3Q3F, T4Q4F, T5Q5F, T6Q6F, T7Q7M, T8Q8M, T9Q9M, T10Q10M T1SSIM, T2SSIF
Social interaction, language and socio-cultural interactions	Social interactions are vital for inclusion of indigenous knowledge in Physical Science	T1Q1F, T2Q2F, T3Q3F, T4Q4F, T5Q5F, T6Q6F, T7Q7M, T8Q8M, T9Q9M, T10Q10M T1SSIM, T2SSIF
Local materials, Indigenous knowledge and Prior everyday knowledge, Mediating of learning and interaction between teachers and learners	Teachers actively seek meaning in the environment to enhance learners understanding in different topics in Physical Science	T1Q1F, T2Q2F, T3Q3F, T4Q4F, T5Q5F, T6Q6F, T7Q7M, T8Q8M, T9Q9M, T10Q10M T1SSIM, T2SSIF
Availability of materials, understanding and benefits to the learners	Factors that influences teachers to include or not include indigenous knowledge in their lessons	T1Q1F, T2Q2F, T3Q3F, T4Q4F, T5Q5F, T6Q6F, T7Q7M, T8Q8M, T9Q9M, T10Q10M T1SSIM
Learners prior everyday knowledge, teachers' experiences and community participation	Advantages and disadvantages that influences science teachers' views and experiences on the inclusion or not including indigenous knowledge in their daily lessons	T1Q1F, T2Q2F, T3Q3F, T4Q4F, T5Q5F, T6Q6F, T7Q7M, T8Q8M, T9Q9M, T10Q10M T1SSIM, T2SSIF

I then combined common sub-themes to form analytical statements and these were linked to the research questions and theory/literature as shown in Table 4.6 below.

Table 4.6: Analytical statements and supporting theory/literature

Analytical statements	Research Questions	Theory/Literature
Views, experiences and pedagogical strategies on the inclusion of IK in Physical Science lessons		
Views, experiences and socio-cultural theory	1	Shizha (2007); Ogunniyi and Ogawa (2008); Mukwambo, Ngcoza, and Chikunda (2014); Mapara (2009); Kibirige and Van Rooyen (2006); Agea, Lugangwa, Obua, and Kambungu (n.d.); Roschelle (1995); Nyambe (2012); Nyambe and Wilmot (2012); Namibia. MEBC (2010), and Vygotsky (1978)
Knowledge is constructed as teachers make sense of their experience on the inclusion of indigenous knowledge	2	
Socio-cultural interaction, language		Vygotsky (1978), and John-Steiner and Mahn (1996)
Social interaction is vital for the inclusion of indigenous knowledge in Physical Science	2	
Social interaction, language and socio-cultural interactions		Vygotsky (1978), John-Steiner and Mahn (1996), Blake and Pope (2008)
Teachers actively seek meaning in the environment to enhance learners' understanding in different topics in Physical Science	2 & 3	
Local materials, indigenous knowledge, prior everyday knowledge, mediating of learning and interaction between teachers and learners		Vygotsky(1978), John-Steiner and Mahn (1996)
Factors that influence teachers to include or not to include indigenous knowledge in their lessons	4	
Availability of materials, understanding and benefits to the learners		Kibiringe and Van Rooyen (2006); Mukwambo, et al. (2014); Aikenhead and Jegede (1999); Ogunniyi and Ogawa (2008)
Advantages and disadvantages that influence science teachers' views and experiences on the inclusion or not of indigenous knowledge in their daily lessons	4	
Learners' prior everyday knowledge, teacher experience and community participation		Roschelle (1995); Maselwa (2004); Mukwambo, et al. (2014); Dziva, et al. (2011), and Vygotsky (1978)

4.7 Analytical Statements

Analytical Statement 1: Views and experiences on the inclusion of IK in Physical Science lessons

It emerged that the teachers who participated in this study have positive views on how IK should be included during their science lessons. They felt that IK has an important connection to what is happening in the community and the environment around the schools. Thus, research findings seem to suggest that these teachers include local/indigenous/traditional knowledge and it is helping learners to link what is happening in the classroom to what is happening in their local community or environment.

Kibirige and Van Rooyen (2006) assert that owning a type of knowledge brings joy and satisfaction to learners and it is highly likely that such learning will increase their retention of the new knowledge. Some indicated that including indigenous knowledge will allow parents to help the learners in the subject matter and participate in the education of their children or work with the teachers in helping learners to present the content of the subject as evidenced by Klein's (2011) study which he conducted with the Nama people in Namibia.

Mukwambo, Ngcoza and Chikunda's (2014) call for the Africanisation of school curriculum would therefore encourage teachers not to avoid such beliefs in the science lessons but to engage with them. Africanisation of school science could allow parents to assist the educators in presenting subject content. Educators should for arrange learners to visit and experience life with knowledgeable people in their communities such as elderly people, scientists, community leaders and scholars of folklore. This type of project could provide many opportunities to teach indigenous science (Ogunniyi & Ogawa, 2008).

In addition, most participants had positive views on the inclusion of local/indigenous/traditional knowledge in Physical Science and indicated the positive aspect of including IK in their lessons. Most teachers emphasized how learners could benefit when indigenous knowledge is included in the lessons. One teacher indicated that:

> *"I think it is important to include local knowledge in teaching Physical Science lessons in Grade 9 because this help learners to relate what they know to what they do not know. This*

will help them to understand better. By including local knowledge will also give opportunity to parents to help their children in the subject" (T_1Q_1F).

Dziva, et al. (2011) argued that if the learner-centred approach is to be taken seriously it should include the learners' traditional knowledge which they bring into the science classroom. Aikenhead and Jegede (1999) posit that a curriculum that allows learners to integrate their indigenous knowledge with science knowledge helps to facilitate cultural border crossing. Vygotsky (1978) points out that social interactions play a critical role in cognitive development in relation to what is learned and when and how learning occurs. Without learning that occurs as a result of social interaction, without self-awareness or use of signs and symbols that allow us to think in more complex ways, we would remain slaves of the situation, responding directly to the environment (Lutz & Huitt, 2004). To this end, one teacher commented that:

> *"It helps us to transfer our traditional knowledge into science curriculum and create rich learning experiences for our learners. Learners learn about sustaining life and protect our planet, energy and resources. It also helps improve our planet and environment for the next seven generation"* (T_5Q_5F).

One male teacher commented that *"the inclusion of local knowledge with Physical Science lessons prevent a cultural divert when the student or learners are learning the meaningful Physical Science"* (T_8Q_8M). To this end, Dziva, et al. (2011) indicated that the difference between scientific and indigenous knowledge continues to create a barrier to meaningful collaboration, as does the widespread assumption that science is superior to other knowledge systems.

Other participants indicated the importance of including indigenous knowledge in their lessons when it came to learners' understanding during the lessons. For instance, two teachers commented that:

> *"During the lessons the inclusion of local knowledge helps learners to understand better because sometimes learners fear Physical Science in such a way that their background about Physical Science was negative"* (T_3Q_3F).
>
> *"I have to include it because they have to start from something that they know that they find in the community then you add to something (western knowledge) that come in, I like to include it I don't want to exclude it because it part of the syllabus"* (T_2SSIF).

The insights from the statements above indicate that teachers need to begin their lessons by ascertaining what the learners already know from home, the environment or their communities into the new worldview of science. A true constructivist teacher will realize the importance of building new knowledge of learners on the existing prior knowledge (Mothwa, 2011). Most teachers in this research showed that including the IK of learners to learn new concepts was an accepted practice Aikenhead and Jegede (1999) showed that for 90% of learners, the movement between the micro-culture (IK) of their family and the micro-culture (science knowledge) of school science is not a smooth process and often limits their success in science. Kota (2006) found that teachers must feel free to use all available resources from the learners' community to broaden the curriculum and to provide better learning.

Analytical Statement 2: Knowledge is constructed as teachers make sense of their experiences of the inclusion of indigenous knowledge

In the questionnaires and during the interviews teachers were asked to reflect on how they were taught science at school and at tertiary level. The reason for this was that I wanted to find out if the way they are teaching Physical Science now is influenced by how they were taught during their time as learners and as students. Most teachers could not recall how they were taught Physical Science at school but a few of the teachers could recall vividly how IK was used during lessons both as learners and as students.

As learners

This was difficult to reflect as most of the teachers had finished school more than five years ago so they could not remember how what they were taught in the classroom linked to their local knowledge. However, there were some who could reflect on how IK was included in the lessons by the teachers either at junior secondary or senior secondary level. For instance, during the interview T_1SSIM explained that:

> *"... normal this thing may depend to a teacher who is teaching you, maybe at school where you have being taught, but they are nothing more differ, there is not that big difference on how we were taught, its only that now there are so many experiments that can we do"* (T_1SSIM).

This revealed that this teacher was influenced by how he was taught at school. However, many science teachers struggle to incorporate IK in their lessons because they were not exposed to it during their time at school (Cronje, de Beer & Ankiewicz, 2015).

Socio-cultural theory rests on the premise that learning is social, and that it is through social interaction with teachers and peers who are more knowledgeable that learners receive assistance as needed in their zone of proximal development (ZPD) to engage in culturally meaningful tasks (Teemant, 2005). Quite interesting T_2SSIF also explained how she was taught Physical Science as a learner and commented that:

> *"Ja it was interesting because I was thinking that I was very fortunate learner because my teacher was so motivated, know the subject knowledge well and he was so even doing practical things with us, it was very interesting that why I even get motivated to learn more in physical science"* (T_2SSIF).

The teacher did not explain whether her teacher used to include IK during their lessons or not but the teacher used to do practical activities using local materials.

The questionnaire responses indicated that three teachers had the experience where IK was included in their lessons when they were learners. A male teacher reflected that *"the experience is that there was little inclusion of local indigenous knowledge but some local plant or petals were used to make dyes or indicators for testing the acidity or alkalinity"* ($T_{10}Q_{10}$M). This clearly indicated that IK was used in Physical Science lessons by teachers to improve the understanding of learners and to make learners connect their environment to what was happening in the classroom. Botha (2010) pointed that "cultural centred education encourages marginalized indigenous youth to have a strong sense of identity, history, and culture in order to deal with the problem of the existence today and in future" (p. 41). Another teacher explained her experiences as *"when I was a learner at school during Physical Science, I believed that IK go hand in hand with Physical Science as a subject because what our forefather or mother taught us long as, we are doing in science"* (T_5Q_5F).

Learners tend to ignore indigenous knowledge when science concepts are introduced to them and they cannot see any link between the two worldviews. Jegede's (1999) theory of collateral learning argues that parallel collateral learning occurs when learners acquire and maintain opposing schemata about concepts and ideas in their long-term memory when learning new science concepts. This theory critiques teachers who tend to ignore IK in favour of western science when teaching science.

Furthermore, a male teacher alluded that one of his teachers used traditional herbs as an example to treat stomach ache. This was what he wrote *"the use of traditional herbs when having a stomach ache was one of my past experience which will act as a base to neutralize acid produced in the stomach which led to the development of Eno"* (T_8Q_8M).

In contrast, the other teachers could not recall whether their teachers included IK in their lessons or not as one reflected *"It was never part of what I was taught in school"* (T_4Q_4F). One teacher clarified why teachers were afraid to include IK in their lessons, she wrote *"people/teachers were afraid to mix traditional knowledge with scientific one as they assume the local traditional one is far behind"* (T_6Q_6F). Aikenhead and Jegede (1999), outline that learners feel that school science is like a foreign culture to them, in order to reduce this sense there is a need to develop culturally sensitive curricula and teaching methods that reduce the foreignness felt by learners.

As students at college, university or technikon

At the tertiary institution, only 40% of the teachers representing four teachers revealed that at the institution of higher education the lecturers used to include IK in the lecturing and they were encouraged to use it during their lessons. The remaining 60% could not remember how they were taught Physical Science or did not answer the questions. One of the teachers wrote:

> *"At college is where I strongly agreed that what we do in our real life situation is what we put into practice in science. I also believed that our traditional knowledge is important because it lead us to a better understanding"* (T_5Q_5F).

The other female teacher who has a Bachelor of Honours with six years teaching experience wrote *"at tertiary level local/traditional knowledge was included as we were allowed to use our own knowledge the things we know already informs our practical and investigation"* (T_6Q_6F). Socio-cultural theorists view learning as integration into a community of practice in which social actions are identified and classroom activities designed (Jaworski, 1993). Teachers were allowed to seek meaning from their surrounding that could enhance teaching and learning.

One male teacher clarified that local knowledge was used at his tertiary institution but the problem was that the names of some of the local plants were not known in English and that prevented them from fully including local knowledge in their lessons. Language was one the factors that prevented the use of IK in their lessons. He wrote *"at college level we were encourage to use local indigenous knowledge but the problem was that some names of local plants are not known scientifically"* ($T_{10}Q_{10}M$). Language is placed in the central position of knowledge construction and acquisition (John-Steiner & Mahn, 1996). Similarly, Blake and Pope (2008) showed that language is an essential tool when teachers scaffold learners in small groups, cooperative learning, group problem solving and in assisted learning. It seems that teachers were not allowed to use the local language to understand the concepts before English was brought in as the language of learning and teaching (LoLT).

Indigenous knowledge is embedded in the local language and learners need to understand it before they transfer to the LoLT. Language plays a critical role in how indigenous knowledge could be integrated in science lessons. It is recognized, however, that indigenous languages cannot describe all the concepts in science which creates problems for the learners. For instance, in Zimbabwe the word for medicine and chemicals is synonymous and are referred to as *mushonga* (Dziva, et al., 2011).

Similarly, another male teacher could vividly recall how the lecturer taught about making a fire when there were no matches available *"one of my past experiences at university was fire making, indigenous people use sticks to make fire which was scientifically developed to a match making in a sense that friction can produce fire"* (T_8Q_8M). I believe that this knowledge that the teacher gained when he was a student was internalized to make more meaningful understanding before it was used during his teaching on the same topic of friction. However, there is an urgent need to equip teachers with the 'knowledge', skills, experiences and materials to address issues of indigenous knowledge in a culturally sensitive and critical way (Webb, 2013). Shizha (2007) argued that the courses taken in teachers' colleges do not incorporate indigenous knowledge in science curriculum and pedagogical practices.

This agrees with T_4Q_4F who explained that during her time at university, indigenous knowledge never formed part of the curriculum. The same teacher indicated that she did include local knowledge in Physical Science on the topic of static electricity. She explained how in her culture, one did not traditionally wear red when it rained or open one's mouths when there was lightning around. Although these examples are not 'scientific' they do link with the influence of culture. Her explanation shows how she used to teach the topic with the inclusion of IK, she explained that traditionally red clothes are not worn when it rained and we do not sleep on our backs, and we do not open our mouths if there is lightning. The explanation does not link to the topic but it is culturally influenced.

Analytical statement 3: Social interactions are vital for the inclusion of indigenous knowledge in Physical Science

This is similar to the studies conducted by Kuhlane (2011) in South Africa and Kambeyo (2012) in Namibia who found that the social interaction teachers have with the communities and environment where they are located helped them to identify local substances that tasted sour. Kambeyo (2012) found that learners could not name local fruits that taste sour from their environment until they interacted with their teachers. Vygotsky's (1978) theory suggests that we learn first through person-person interaction and this is the basis of social interaction which promotes gradual changes using social contact and language resulting in development. He believed that learners construct their own knowledge by interacting with other individuals (Blake & Pope, 2008; Stott, 2016).

John-Steiner and Mahn (1996) maintained that social interaction is based on the concept that human activities take place in cultural contexts and are mediated by language and other symbolic systems. Mediation is the key to this approach to understand how human mental functioning is tied to cultural, institutional, and historical settings since these settings shape and provide the cultural tools that are mastered by individuals (ibid).

Language is an essential tool for teachers to be able to scaffold learning. This research found that language plays a role in how indigenous knowledge is integrated into science lessons. $T_{10}Q_{10}M$ indicated the issue of language when he was a student at college, in that the lack of terminologies in the local language prevented them from including IK in the lessons. Mukwambo, et al. (2014) illustrated the necessity of developing social language into the language science teachers need to pose questions, create arguments and design purposeful experiments. Science concepts are not always explicit in most indigenous practices, but the Africanisation of the school science curriculum calls upon the teachers and learners to attach scientific explanation to IK (ibid).

Analytical Statement 4: Teachers actively seek meaning in the environment to enhance learners' understanding in different topics in Physical Science

Most teachers shared their thoughts on the inclusion of local/indigenous/ traditional knowledge in their lessons. IK is home or community or cultural based knowledge that differs from one culture to another even though there is some commonality. Most teachers linked the indigenous knowledge they experienced at home with western science or knowledge. Teachers seek meaning from home, community and school to assist the learners to understand the concepts.

At home

Indigenous knowledge as defined in Section 4.3.1 is a micro-culture of a particular community, developed in response of the culture's need to understand, predict and influences its environment over a long period of time and passed on from generation to generation (Mukwambo, Ngcoza & Chikunda, 2014). Teachers had different indigenous knowledge that related to western science at home. One teacher moved that:

> *"Do not open your mouth when it is raining and there is lightning because the teeth are made of calcium (it has Ca^{2+}) that can be attracted to the lightning. Do not stay closer to animals if there is lightning because their fur are always charged and can be attracted by a lightning"* (T_4Q_4F).

Elderly people do not allow people to laugh when there is thunderstorn as lightning might strike. Teeth are made of calcium which can conduct electricity. This is a cultural belief but when we look at a scientific explanation, calcium is in group two and it has two electrons on its outer shell. It can easily lose two electrons on its outer shell and become the positive ions (Ca^{2+}) that makes it a more reactive element on the periodic table. This might make it react with the negative charge discharged by lightning. Only part of the specialized knowledge can exist explicitly as information, the rest must come from engagement in the discursive practices of the community (Roschelle, 1995). The other respondent a female teacher stated:

> *"The process of producing a vambo liquor can be related to fractional distillation method in Physical Science as a method for separating mixture, and use homemade substances and classify them as acids and bases e.g. Sour milk, Oshikundu etc. but not only the laboratory substances"* (T_1Q_1F).

The process of making traditional liquor was also mentioned by a female teacher as a process that happens at home and it relates to western science by saying *"at our home I know things like brewing ovambo-liquor namely ombike. This is done through distillation and preparing home-made beer called Oshikundu"* (T_6Q_6F). In a study by Shifafure (2014) learners gained a lot of knowledge from the process of *Kashipembe* which they connected to the concepts related to distillation. *Kashipembe* is one of the home made beers that has a high concentration of alcohol.

Similarly, the other teacher explained that *"cooking - local knowledge ideas of cooking are all the same as those of western ideas, and spacing of food- the ideas of making food tastier by using local knowledge and western ideas are the same"* (T_8Q_8M).

$T_{10}Q_{10}M$ posited that plants found at home can be used in the laboratory as dye or indicators to test for acidity or alkalinity of different substances. He said that *"there are some local plants that can serve as dyes and can be used in laboratories to identify substances"*. This knowledge can be useful at school where litmus papers and indicators are not available and also to show the learners that some of the plants that they see in the environment are equally useful as laboratory materials or substances. In their studies, Kuhlane (2011) and Kambeyo (2012) discovered the use of local available materials to teach acids and bases enhanced learners' understanding of the topic. It seemed clear that using learners' prior everyday knowledge as a starting point for the exploration of scientific concepts and inquiry procedures served to enhance learning (Kambeyo, 2012). During the interview with T_1SSIM he revealed that:

> *"In our, in our homes people when they are making the liquor or beer whatever it called, which is now made from fermented fruits that will be now a kind of alcohol mixing with water, it's what they try to do when they a making this, it's to make sure that the alcohol is pure taken or separated from the mixture"* (T_1SSIM).

The teacher was explaining the life experience that he gained at home that could be applicable in teaching science. The process of making traditional beer involves different processes that are applicable in science, 'fermenting fruits' and separation of the mixture (simple or fractional distillation). Shifafure (2014) did his research on how the making of *Kashipembe* could enhance learners' understanding on the topic of fractional distillation. His research involved a local community that produced *Kashipembe (ombike)* to explain the concept to the learners and to allow the learners to see a practical demonstration of fractional distillation.

In the community

This section of the questionnaire aimed to find out what else is happening in the community that relates to western science. Two teachers did not respond to this question which represents 20% of the participants. This part of the question was well answered and many teachers gave examples of indigenous knowledge in the local communities that connect to western science.

Making of traditional beer was a good example of a scientific process occurring in the community. The process of making *Otombo (traditional beer made from fermented sorghum)* is used in industries where they use the some process of fermentation to make alcohol.

> *"In my community people also ferment traditional beer called otombo whereby they sorghum is added in a bucket with water and sugar and it left to ferment the whole night to produce alcohol and carbon dioxide"* (T_6Q_6F).

Adding to this, one participant recalled that *"the process by which ombike is prepared is the same as distillation"* (T_4Q_4F).

T_{10} $Q_{10}M$ from the Zambezi region also commented on the process that elderly people use when they brew their traditional beer called *Chikotini* or 7 days (*traditional beer brewed from fermented sorghum mixed with maize meal and boiled for 4-6 hours)*. The process involved scientific terms that are also embedded in other processes that occur in the area where this research was conducted. He responded:

> *"Elderly people back home used to brew traditional beer that involve several scientific process that can be used in the classroom situation, for examples, during the brewing process they let the content to ferment or they add what we call mulungo (catalyst) to speed up the process"* ($T_{10}Q_{10}M$).

One of the findings of this research on cultural norms and beliefs in making traditional liquor was that 'knowledge was culturally embedded'. Indigenous people had diversified their skills when making traditional alcohol and the number of home brewed alcohols is increasing in number. All this alcohol brewed at home involves the process of fermentation using fruits like *Eenyandi (berry fruits), Sorghum, Mahangu*, and other fruits found in the local community.

Apart from liquor, indigenous people have developed knowledge of how to treat different diseases by using traditional plants. Indigenous people are known for their awareness and skill when it comes to treating different diseases. T_9Q_9M indicated that:

> *"Traditional healers use local knowledge to treat people on different diseases which is the same as the ideas of western culture, and indigenous people use their local knowledge to cultivate their crops which is the same as the western"* (T_9Q_9M).

Traditionally, when someone is having flu, people would treat the person with (*Mupulanga*) leaves by steaming them. The flu would disappear within one or two days. Coughing was not a problem in the olden days because it could be treated with different traditional herbs. Leadwood, family name Combretaceae (*Muzwili in Silozi*) used to treat running stomach. In support of this, Chinsembu and Hedimbi (2010) in the research conducted in Caprivi Region now (Zambezi) Combretaceae (*Muzwili*) leaves are used to treat Malaria and diarrhea by steaming and drinking. Other plants like chikolwa/Gavakana (Aloe) were and are still used to heal people who are suffering from stomach ailment (Mapara, 2009).

In support of T_9Q_9M, Ogunniyi and Ogawa (2009) illustrates that African indigenous people classify soil using colour, texture and structure. They use indicator plant such as sorghum (in my culture, Zambezi Region) for deciding the suitability of soil for a given cropping system. They classify plants according to how they grow in different types of soil and their habits when growing (ibid). In his research on sound and waves Liveve (2016) found that learners can be taught using the traditional drum that they are familiar with at home to enhance the conceptual understanding on the topic.

During the interview, T_2SSIF was asked about using indigenous knowledge from the community. This was what she responded:

> *"Uhh, they are quite many because when we are talking of Physical Science this has to do with almost things around us, so when we are talking also looking at materials building houses, making traditional pots so you can even ask learners to bring traditional materials made from local different type of materials like ceramics, wood and others thing then you can also say this is also part of our indigenous materials that we can also use at school, by bring you ask learners they can also say eee this is the thing that we use at home that is also part of science"* (T_2SSIF).

In summary, most teachers knew about the scientific processes that are happening in their community that could be related to western knowledge. Different activities that are carried out in the communities could be helpful in teaching Physical Science in schools especially the making of traditional beverages, *Otombo, Ombike and Oshikundu* for the topics of fermentation, fractional distillation and rate of reaction respectively.

At school

Schools are the place where indigenous knowledge causes uneasiness for the teachers and learners. This was revealed by the responses in the questionnaires. As one participant noted *"mostly at school we use western or scientific ideas because are noted in books"* (T_9Q_9M). The response from T_9Q_9M vividly indicated that IK is not documented and it is difficult for the teachers to incorporate it into their lessons. This agrees with Shizha (2007) who posited that teachers did not deviate from what was presented knowledge in textbooks as they considered this as knowledge worth learning.

Other participants had a clear understanding of how they could relate IK to school science. This was revealed by three teachers when they explained in their questionnaire responses that:

> *"At school indigenous knowledge is only used to make learners to understand the lesson, this knowledge cannot be written in tests or examination so there is little time given to them during the lessons"* ($T_{10}Q_{10}M$).
>
> *"At our school learners and teachers do produce carbon dioxide whereby they prepare traditional bread called omungome, they prepare dough and left it to rise for some minutes"* (T_6Q_6F).
>
> *"Making indicators by using plant materials such as red cabbage, beetroot and red flower that can be used as a universal indicator to indicate whether a substances is acid or alkali"* (T_1Q_1F).

Something that emerged from the questionnaire was that teachers showed an understanding of how IK could be included in the science classroom by giving practical examples of what learners brought from home. The traditional bread (*omungome made from mahangu flour*) and filtration are common examples that learners are familiar with and are observed or practiced on a daily basis at home and in the community. However, it must be remembered that indigenous knowledge is context dependent and it is unique to a given culture.

Boven and Morohashi (2002) clarify that indigenous knowledge is the local knowledge that is unique to a given culture or society, in addition local knowledge is vested more in agriculture, health care, food preparation, education, natural resource management, and a host of other activities in rural communities. Moreover, IK may be related to a common practice seen in a community that are indigenous to a specific area or the focus might be on a long history of the practice, in this case it is often called traditional knowledge (Boven & Morohashi, 2002). The data from the questionnaires revealed that most teachers could supply examples common to their local environment. When asked about their IK on building houses, this was the outcome.

Most communities use thatched roofs and walls made out of mud to protect them from rain and wind and to warm the rooms. Indigenous people use materials that are easily available to build their houses, a kraal for animals, and fence their yard. The most common descriptions in this section given by 80% of participants was the 'use of poles from local trees for roofing and wall structure and grasses for covering the roofing'.

T_5Q_5F described how the community are improving their skills and now make bricks from mud. Her response was *"Clay soil is used to make bricks in order to construct traditional hut and roof can be made from grass and hay as well as sticks"*. This indicated that indigenous knowledge does not stagnate but improves with time. T_1Q_1F agreed with T_5Q_5F by stating that *"Making bricks and thatching, we normally use clay soil to make bricks for building sleeping rooms and cut grasses and use them as thatching roofs"*. *"Homes and huts can be made from clay soils without using cements and stones"* (T_7Q_7M). T_9Q_9M and $T_{10}Q_{10}M$ responded that the buildings are made stronger by making a wall with wooden poles covered with a mixture of mud (clay soil) and animal dung and roofing can be built from the wooden poles covered with grasses (thatching roofs).The context in which this knowledge was developed was to use clay soil and grasses to build houses. Teacher T_1Q_1F and T_7Q_7M are Kwanyama and T_9Q_9M and $T_{10}Q_{10}M$ are from others tribes and a Zambezian respectively. This shows how IK is context embedded because teachers from the same culture use the same indigenous practices.

Lightning was often linked with many traditional beliefs and teachers, as part of the community, shared their local knowledge about lightning. The findings of this research shows that lightning can strike moving objects and tall objects which are scientifically proven facts and the other findings are believed to be cultural beliefs that cannot be proven. These findings were categorized in the table that follows:

Table 4.7: Shows the scientific and cultural beliefs of teachers about lightning

Scientifically proven	**Cultural beliefs**
The use of an earth wire on a tall building to prevent lightning from striking the building.	- *People prevent the lightning by putting certain piece of tree (Omulavi) on top of the huts and if the lightning strikes one place make sure you do not come in contact with that place until it is cleaned* (T_6Q_6F) - *People use 'Omulavi' a plant/tree used to prevent the lightning and its branch used to be placed on top of the hut* (T_7Q_7M) - *Wood called (Omulavi) a branch erected on top of the hut to prevent it from strike by lightning* (T_2Q_2F)

Three teachers indicated that using a branch of a tree called *Omulavi (a traditional tree that has very small leaves and thick stem)* placed on the roof of the hut or room would prevent it from being struck by lightning. All three teachers are from the Kwanyama (see Section 4.2.1).

Kibirige and Van Rooyen (2006) indicated that IK is locally derived from interactions between people and their environment. Thus, it is not easily shared with members of another community.

Analytical Statement 5: Factors that influence teachers to include or not include indigenous knowledge in their lessons

The teachers shared the factors that influenced their inclusion of indigenous knowledge in their lessons. The findings in this research indicated that teachers included IK during their teaching to help learners understand science concepts. However, some teachers said that the lack of materials which showed them how and when to include IK in their lessons, together with their lack of indigenous knowledge made it difficult for them to include it. Teachers had mixed feelings about the factors that influenced their views and experiences on the inclusion of local knowledge as alluded to below. A male teacher explained that *"it is always good to start from the known to the* *unknown, so the known part is about the local or indigenous knowledge"* ($T_{10}Q_{10}M$).

According to Roschelle (1995), new knowledge does not replace prior everyday knowledge; rather new knowledge re-uses prior everyday knowledge. She further indicates that knowledge begins with the selection of ideas from everyday experience or PEK. Ideally, learners build on a foundation of robust and accurate prior everyday knowledge, forging links between previously acquired and new knowledge that help them construct increasingly complex and robust knowledge structures (Won, n.d.).

Three teachers clarified what inspired them to include indigenous knowledge in their lessons as understanding, local traditional methods, familiarization and knowledge. The teachers' exact words were: "*It is needed to educate learners that local materials or substances are used also in science"* (T_2Q_2F), and "*this allows learners to familiarize themselves with what they already know"* (T_6Q_6F).

> *"This is because this make things easier for the learners as the examples of local knowledge relates the scientific ideas to some of the prior knowledge of learners which make it easy for learners to understand"* (T_8Q_8M).

Most teachers cited the benefits that IK can bring to the science classroom, as illustrated by the three teachers above.

During an interview with T_1SSIM, he mentioned that including indigenous knowledge made his work easier for him and for the learners because learners used their prior everyday knowledge gained at home which made the lessons easier and more interesting.

> *"There is a very big, most of these things have good advantage, have benefited the learners, this is because science is something let say first belongs to the western people and so on, but the moment this knowledge, local knowledge is being included this will make work easier for our learners because they are some of the things that you maybe mentioning in the lesson at a school in the village and no one will have the ideas of that"* (T_1SSIM).

Concurring, T_7Q_7M commented that: "*It makes a person (learners) to understand very well how or what something is to be done"*.

There was a contradiction between scientific knowledge and indigenous knowledge as much of the indigenous knowledge is myth and cannot be proven. This was the factor stated by T_4Q_4F on why she did not include IK. *"The scientific knowledge that I have learned in school, and some of the indigenous knowledge cannot be proved, they are myth"* (T_4Q_4F). The response from this teacher indicates that both scientific knowledge and indigenous knowledge are myth. I am more interested to see how this teacher answered the question on how she was taught Physical Science when she was a learner. To say that the scientific knowledge she learned at school was a myth required an explanation. The teacher indicated that she was never taught IK at school (T_4Q_4F).

The other participants indicated that *"Lack of indigenous knowledge among learners as well as teachers, and parents are not available to deliver traditional technology"* (T_5Q_5F). *"Community understanding most people do not want to disclose on how they do their things"* (T_6Q_6F) and *"Materials available, sometimes the materials are not available, limited time, and lack of experience on a certain subject content"* (T_1Q_1F). Mothwa (2011) found that when teachers are not well trained in application methods, they become confused about how to implement indigenous knowledge in their classroom. This could be the result of insufficient training and professional development on how teachers should infuse IK in their teaching (ibid).

According to Dziva, et al. (2011), science teachers find it difficult when incorporating IK in their lesson as they believe that their role is to teach scientific concepts and theories as required by the syllabus, they are anxious about how to manage the diversity of ideas and their religious fear of God. This research revealed that not all teachers know much about the indigenous knowledge of the communities they serve. This was particularly challenging for teachers teaching IK as it is context oriented and culturally embedded.

Lastly, one male teacher argued that IK cannot be scientifically proven which makes it difficult to include in lessons. He said "*sometimes there is no scientific proof*" (T_9Q_9M). In support of this Cronje, et al. (2015) posed that teachers fear that they will be teaching pseudoscience when integrating indigenous knowledge into western science as indigenous knowledge has not been proven scientifically nor is it based on scientific methods. Aikenhead and Jegede (1999) point out that the cultural clashes between learners' life-world and the world of western science challenges science teachers who embrace science for all. Cultural clashes can happen to anyone and teachers have to be sensitive when learners cross from their life-word (indigenous knowledge) into the scientific world of knowledge. These cultural clashes can create dissonance for many learners (Le Grange, 2007).

Analytical Statement 6: Advantages and disadvantages that influences science teachers' views on the inclusion or not including indigenous knowledge in their daily lessons

Advantages

Participants were also asked to sate the advantage of including indigenous knowledge in their lessons. This question was well answered by both participants from the questionnaires and semi-structure interviews. The advantages of including IK mentioned by the participants are:

Table 4.8: Advantages of the inclusion of IK in Physical Science

Advantages of including IK in Physical Science lessons
• *makes learners understanding things in his/her language;* • *it relate the concepts to what learners already knew and it makes the lesson more interesting and all learners will pay more attention;* • *the traditional knowledge learners they learn them a lot from their parents;* • *it makes it easy for learners to understand and it is easy to bring real life examples in the classroom that learners know from home;* • *it helps learners to relate what they know to what they do not know* • *it saves money because they are locally available;* • *to identify the link between modern science and traditional science;* • *learners will understand well and fast;* • *learners will develop a positive image of the subject;* • *learners will be motivated to become future science teachers;* • *learners will understand more because they are relating what they are taught to what they see happening at home or in the community;* • *it helps learners to think critically on the topic and to reflect back on the traditional knowledge;* • *it helps learners to pass well in tests, homework as well as examinations because they reflect back quickly on what they did during the science lesson; and* • *this broadens the knowledge of the learners in such a way that learners are exposed to different situations.*
Similarly, the interviews with T_1SSIM and T_2SSIF revealed that:
• *learners can feel that if things we are using at home is also part of their learning, so they can also know how to take care of their things;* • *indigenous knowledge benefit the learners, this is because science is something lets say first belongs to the western people and so on, but the moment this knowledge is locally*

available;

- *local knowledge will make work easier for our learners because they are some of the things that you might mention in the lesson (western knowledge) at a school in the village and no one will have the ideas;*
- *learners can only get to understand and to know what does the thing mean or does the content mean only when we can give example from the local knowledge being brought up that when one can open up and understand; and*
- *it makes learners to be active, to understand concepts better, and even to know how to apply something in real life experience.*

Most participants agreed that the inclusion of indigenous knowledge in Physical Science lessons will improve learners' understanding. The finding suggests that teachers need to include indigenous knowledge in their lessons to make work easier for both the learners and the teachers. Most teachers romanticize IK as the only solution that could help learners to understand science concepts better or for the learners to have a clearer understanding. Dziva, et al. (2011) agree that learners inhibit their learning of science because their preconceptions make more sense to them than many of the counter-intuitive concepts found in science. In support of this, Mothwa (2011) discovered that IK should encompass the so-called scientific methods and should assist learners in developing critical thinking skills. This may only be achieved if teachers plan their lessons based on the indigenous knowledge the learners know from the community or the environment. I would suggest that based on these findings IK needs to be the foundation on which western knowledge is built in the classroom situation in Endola circuit. Most teachers who participated in this research acknowledged the advantages of including IK in their lessons.

Disadvantages

In contrast, indigenous knowledge does have disadvantages that might affect the way it is included by teachers in Grade 9. Both data from the questionnaires and interviews showed that indigenous knowledge has the disadvantages illustrated below:

Table 4.9: Disadvantages of the inclusion of IK in Physical Science

Disadvantages of including Indigenous Knowledge in Physical Science
• *if some of the learners are not from the local environment it might be difficult for them to understand* • *some indigenous knowledge is not approved due to lack of information* • *learners are from different traditions and thus they will not understand some of the knowledge from a different tradition from theirs* • *sometimes it is time consuming, learners use up more time to respond to the questions* • *lack of indigenous knowledge among learners because parent do not stay with their children to deliver spirituality skills* • *there might be some contradiction between indigenous knowledge and new knowledge (western knowledge)* • *the learners could not answer questions in their mother tongue when they are in an examination session* • *some of the facts you cannot prove them or there is no evidence* • *the knowledge may not be universal, since these examples are not in other languages, cultures or countries* • *concepts are not well developed in indigenous language (let's say on putting this some of these things in the language that you teach in the subject, Physical Science is quite ... and sometime you want to include a certain concept in lesson but you will not have that words you don't, you will not know which word must I use in order to explain this clearly to the learners)* • *some topics may not have that good examples to use IK* • *textbooks most of the things there are western knowledge, we can say that indigenous knowledge is being excluded in the textbooks* • *indigenous knowledge can be seasonal, not found all the time, not available so they got seasonal time*

However, 30% of the teachers from the questionnaire analysis and 50% from the semi-structured interviews were of the opinion that the inclusion of IK could affect the learners since it is not documented in the textbooks and learners who are not from the environment will be affected as they will not be able to connect the IK to western science. This suggests that IK is culturally embedded and environmentally oriented.

Dziva, et al. (2011) explained that IK does not make any distinction between the mind and matter. Concepts are not well developed in indigenous languages as one participant indicated during the interviews:

> *"Let say on putting this some of this thing on the language that you teach in the subject, Physical Science is quite difficult and sometime you may have want to include a certain concept in the lesson but you will not have that words you don't, you will not know which word must I use in order to explain this clearly to the learners"* (T_1SSIM).

According to Cronje, et al. (2015), the disadvantages reveal themselves as a lack of instructional methods and pedagogical content knowledge. That is, teachers have not been exposed to this type of training themselves since they were trained in western science and hence they struggle to incorporate indigenous knowledge into their classrooms.

4.8 Concluding remarks

This chapter began by presenting quantitative and qualitative data that were obtained from the questionnaires. The quantitative data showed that the teachers involved in this study know and include IK in their lessons to enhance their learners' understanding. The qualitative data from the questionnaires (open-ended questions) and interviews were triangulated with the literature to find a correlation. The findings showed that teachers are familiar with the use of IK in Physical Science lessons.

In the next chapter, a summary of the findings, some recommendations, conclusions, limitations and personal reflections are presented.

CHAPTER FIVE

SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

African indigenous people classify soil using color, texture and structure even before studying school science. Most African learners have accumulated a wealth of holistic knowledge about their environment which school science with its compartmentalized disciplines have tended to displace rather than accommodate (Ogunniyi & Ogawa, 2009, p. 182).

5.1 Introduction

The main aim of this study was to explore Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) in their lessons and the pedagogical strategies that they use when doing so. This study was thus triggered by the need to integrate indigenous knowledge in science lessons. Research shows that integrating indigenous knowledge into science lessons helps learners to make connections between the indigenous and western worldviews (Le Grange, 2007; Mapara, 2009) and the above epigraph illustrates this. Drawing from Aikenhead and Jegede (1999), cultural border crossing helps non-western science learners to make a meaningful transition from their prior everyday knowledge, which could be in the form of indigenous knowledge, into science content knowledge. Furthermore, the culture of learners' immediate environment plays a significant role in their learning and that it determines how concepts are learned and stored in the long-term memory as schemata (Le Grange, 2007).

The study employed a mixed methods research design. That is, a combination of both quantitative and qualitative methods were used to generate data. Principally, data were generated using questionnaires and semi-structured interviews. I used Vygotsky's (1978) socio-cultural theory as my theoretical framework and this was used as a lens to analyze my data. Quantitative data were presented in tables and graphs; whereas qualitative data were analyzed inductively and sub-themes and then analytical statements were formed.

5.2 Summary of findings

The data generated were analyzed to answer four main research questions. A summary of findings for each research question is presented.

Research Question 1

What are Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) in their science lessons?

In response to this research question, teachers clarified the views as presented in Chapter Four (see Section 5.7, Analytical statement 1). The study found that teachers are positive about the inclusion of local knowledge in science lessons as it aids the learners' comprehension of the concepts. The results further indicated that most teachers do incorporate traditional/local knowledge or indigenous knowledge when teaching Physical Science. It was interesting to note that the teachers regarded indigenous knowledge as the prior everyday knowledge of learners which they should start with when teaching any topic in science as proposed by Roschelle (1995). It was revealing to find that the teachers in this study embraced the inclusion of indigenous knowledge stating that it stimulates learners' understanding and interest in lessons. For example, the use of *vambo beverages such as Ombike, and Otombo* and *Oshikundu* to teach topics like fractional distillation, acids and bases, and fermentation was a recurring theme mentioned by the teachers. The inclusion of IK might give the parents the opportunity to demonstrate the processes that are involved when making *Ombike, Otombo and Oshikundu* which supports Vygotsky's (1978) socio-cultural perspective that we learn through social interaction.

Some participants indicated that the curriculum or syllabus influenced their views on whether to use local knowledge in their lessons. The National Curriculum for Basic Education allows teachers to incorporate the life experience of learners in their lessons and learners' needs within their environment and community (Namibia. NCBE, 2010). The quantitative data revealed that 60% of participants strongly agreed and 20% agreed that IK should be part of the curriculum. Regarding the syllabus, 80% agreed that IK should be part of the syllabus.

Teachers in this study agreed with Kibirige and Van Rooyen (2006) who asserted that when learners connect what they know from home to what is learnt in the classroom it brings joy and satisfaction.

Research Question 2

What kinds of local/traditional knowledge (indigenous knowledge) do Grade 9 Physical Science teachers have or do not have in teaching Physical Science topics using local/traditional knowledge (indigenous knowledge)?

This research question showed that teachers could elaborate on topics such as acids and bases, friction, combustion *etcetera* by including IK (see Section Table 4.2 and Figure 4.1). The findings show that teachers are conversant with indigenous knowledge and they are well informed on how it can be incorporated into science. In the study by Kota (2006) she found that learners were able to relate what they observed at home with science in the classroom. "*I know how to make fire. I just watched how it was done, then that's how I learn, there was no book" (ibid).*

These teachers further showed a variety of indigenous knowledge in farming, medicine, building, and lightning that is applicable in Physical Science and other science subjects. It is for these reasons that Mukwambo, et al. (2014) call for the Africanisation of the science curriculum in order to include the knowledge of local people in school science. This might allow parents to have a role in the education of their children (Klein, 2011).

Research Question 3

Where and how do science teachers use local/traditional knowledge (indigenous knowledge) in their science lessons?

In response to this question, the research discovered that when indigenous knowledge is integrated into science lessons the engagement between teachers and learners improves. Socio-cultural theory (Lemke, 2001; Vygotsky, 1978) rests on the premise that learning is social. Furthermore, social interaction between teachers and learners allows engagement in culturally meaningful tasks (Stott, 2016; Teemant, 2005). At home teachers and learners acquire local knowledge through the social interaction with the community which is applicable in Physical Science. The research also revealed that IK is more useful during practical demonstrations.

Teachers also showed their appreciation of how indigenous knowledge could be used in farming production, medicine, brewing of homemade drinks or beers, building, predicting weather or rain and lightning. In medicine, for example, T_8Q_8M indicated that *"the African potato for example has traditionally been used for its many medicinal properties, traditional healers used it to treat cancer, so the western developed a medicine that enhances the body natural defense system"*. Other plants like *chikolwa/gavakana* (Aloe) were and are still used to help people who are suffering from stomach ailments (Mapara, 2009). Kibirige and Van Rooyen (2006) showed that:

> Khoi San and Zulu healers have long known about the potent medical qualities of the 'cancer-bush' *sutherladia frutescens*. Patients suffering from cancer respond well to extracts made from this plant. Its leaves and flowers are put in boiling water, and patients drink the infusion. (p. 6)

Research done by Uushona (2013) and Shifafure (2014) in Namibia found how the scientific processes done in the community in brewing alcoholic beverages could enhance learners' conceptual understanding of fermentation and distillation during science lessons.

Research Question 4

What factors enable or constrain Grade 9 Physical Science teachers to make use of local/traditional knowledge (indigenous knowledge) in their science lessons?

Most teachers in this study indicated that using local materials lead to learners having a positive image of science. They emphasized that IK helps learners to recall what they were taught in examination. Moreover, the findings revealed that teachers in this study were able to name the factors that enable them to include local knowledge in Physical Science, such as availability of local materials, and starting from the known to the unknown were highlighted (Kuhlane, 2011). Thus, it is when the culture of the learners' immediate environment is accommodated, it plays a significant role in learning and determines how concepts are learned and stored in the long-term memory as schemata (Le Grange, 2007).

The participating teachers also pointed out that IK has disadvantages when incorporated into science classrooms. For example, they mentioned that the terminology of the local language cannot encompass all the concepts in science which corroborates Dziva, et al.'s (2011) and Shizha's (2007) findings in their studies. The teachers highlighted aspects such as, lack of concepts in our local language, time consuming, no proof, and that indigenous knowledge is seasonal (see Table 4.7).

Additionally, some teachers referred to learners' lack of indigenous knowledge, limited time, lack of experiences in subject content, and the unwilling participation of the community as some of the reasons why they do not use local knowledge in science lessons. Cronje, et al. (2015) support this by stating that a lack of understanding of the nature of science and the nature of indigenous knowledge hampers the inclusion of IK in science lessons.

Language issues also emerged as a problem in this study. Indigenous knowledge is embedded in cultural practices of which language plays a role. Use of indigenous language allows learners to assimilate information faster than the language of learning and teaching (LoLT) (Cronje, et al., 2015). Hence, Shizha (2007) highlighted that learners taught in their home language performed significantly better than those taught in English.

5.3 Recommendations

The research prompted many possibilities for further research in the field of indigenous practices that could be included in science lessons to enhance learners' understanding. The first recommendation is that teachers should explore different indigenous practices that are linked to the topics in the curriculum or syllabus to enhance learning and teaching. By doing this they could involve local community members who have advanced indigenous knowledge to help deliver the lessons as evidenced by Klein's (2011) study. Through working in collaboration with community members, science teachers could develop learning and teaching support materials using easily accessible materials (Asheela, 2016).

Secondly, curriculum developers should plan how to integrate indigenous knowledge in the science curriculum. After analysing the syllabus for Grades 8-10, I discovered that it encourages teachers to start from life experiences, and to use local examples where possible but the how part is missing. This suggests that there is a need for the professional development of teachers on how to incorporate IK in their science lessons.

Textbooks are not much of help to teachers on how to include the IK of the communities to help learners in the classroom. For textbooks to include IK, terminologies need to be developed in the local language and translated into the LoLT. The research also found that textbooks need to include IK for teachers who come from different communities to support their teaching and use of relevant examples.

The following recommendations need to be implemented:

- Develop a training program where all science advisory teachers are trained in order for them to support science teachers on how they can include IK in their science lessons;
- Develop programs that encourage both teachers and advisory teachers to develop learning and teaching support materials (LTSMs) which take the incorporation of IK into consideration;
- Community members need to be involved in presenting or demonstrating indigenous practices during science lessons. This would allow learners to ask questions in their local language for better understanding, and the teachers could serve as the translators from local language into LoLT;
- Indigenous knowledge needs to be documented;
- Indigenous languages need to be used interchangeably with English in the science lessons where IK forms the central part of the topic to be discussed;
- Use of mind maps and concept maps in which learners could show the links between concepts as proposed by Kambeyo (2012) in his study in Namibia should be explored; and
- Teachers should share best practices and observe each other's lessons when incorporating IK in their science lessons.

5.4 Areas for future research

This research serves as a stepping stone for future research on the inclusion of IK in Physical Science lessons. Further suggestions for research include:

- A study on the inclusion of IK in Physical Science where teachers would be observed teaching;
- A study on the learners' views and experiences on the inclusion of IK in Physical Science

lessons;

- The impact of local knowledge in the Science curriculum on the performance of junior secondary learners in Namibia;
- A study on the commonality of indigenous knowledge applicable in all 14 regions of Namibia for Physical Science;
- A study on the roles of parents or community members on the inclusion of indigenous knowledge in Physical Science; and
- Since this research focused on the inclusion of local knowledge in Physical Science Grade 9, I would like to see similar studies in other science subjects such as Agricultural Science, Biology and Life Science and possible for other grades.

5.5 Limitations of the study

The findings of this study were limited to only 10 teachers in the Endola circuit; and therefore it cannot be generalized to the whole region or country. As only 10 questionnaires were returned by the sample this affected how representative the findings are of all the teachers in the Endola circuit of Ohangwena region. But the data from the questionnaires were complemented and triangulated with interview data. The other limitation was time constraints. Being a school principal and a teacher meant that valuable time was spent attending workshops and other managerial activities. However, despite these limitations, useful insights on the inclusion of IK in science lessons have been provided by this study.

5.6 Reflections

This research journey did not start in 2015 but it started in 2013 when I enrolled at Rhodes University. In 2014 when Prof Ken Ngcoza taught us indigenous knowledge, I could not believe that something that I grew up with was actually documented and being researched on how best it could be included in science classrooms. My interest in IK escalated and I could not wait to join the families of IK researchers in the Namibian context.

This research started with the most difficult step, to realize my dream I had to write the research proposal. I was born and raised by rural parents who depended mostly on traditional medicine whenever someone was sick, traditional food and traditional ways of farming. With this at heart I did not want to concentrate on one topic in my research. My research interest was *exploring Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (Indigenous Knowledge (IK)) in their lessons: A Namibian case study.* This proved interesting because I was not doing the research in the area where I was born and raised. This was an opportunity to learn and acquire new local knowledge that could be integrated into science lessons to enrich my personal knowledge I gained at home when I was growing up and at school.

When my proposal was approved I was over the moon that the journey into the real world of researchers had opened up for me to make my personal contribution to the field of IK in Physical Science. I found this entire research journey to be an eye-opener and to be a wonderful learning experience.

5.8 Conclusion

In this chapter, I discussed a summary of the findings in relation to each research question. I thus briefly highlighted the main findings, recommendations, limitations of the study, areas for further research, and also reflected on my research journey**.** The study revealed that most of the teachers in Endola circuit understood the importance of the inclusion of IK in their science lessons and indicated that they included it when teaching Physical Science. They also pointed out the challenges that teachers face when integrating IK in their lessons. IK is context dependent and teachers need to be knowledgeable about the IK of the community before they are able to incorporate it into their science lessons. The other possibility is to use knowledgeable community members to help them to present some lessons.

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Appendices

APPENDIX A: LETTER TO THE DIRECTOR OF EDUCATION

REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION ART & CULTURE: OHANGWENA REGION

Circuit: Endola **Cluster: Shituwa**

ONEPANDAULO COMBINED SCHOOL

Tel: (065) 225072
Fax: 065 225187/0886552121

P. O. Box 157
OSHAKATI
NAMIBIA
10 June 2015

Enquiries: Mr. Fredrick Simasiku @ 0811284219
E-mail: wadingha@gmail.com

TO: Mr. Isak Hamatwi
Director of Education
Ohangwena Region

Subject: Request for permission to conduct educational research in Ohangwena region

I, **Fredrick Simataa Simasiku** student number **13s7222** currently doing a masters in science education with Rhodes University hereby seek permission to carry an educational research in you region. I am currently a first year planning to carry my research as from January 2016. I wrote this letter so early because I still have to attach your response when seeking permission from the Inspector of Education to help me in delivering questionnaires to and from their circuit. I still need to inform principal of schools in Ohangwena region having grade 8 – 10, since my research will be based at that level.

My research interest is to **exploring grade 9 Physical Science teachers' perceptions and experiences on the inclusion of Indigenous Knowledge (IK) in their lessons in Ohangwena Region: A Namibian case study.** The research question was driven by my teaching experience as a physical science teacher in Ohangwena region and the remoteness of the region. I ignored to use IK of learners in my lessons and this motivated me to carry a research and find the solution the problem. Many African country still neglecting the use of IK in schools and depend mostly on the western knowledge which have it anchor on our IK. The teaching pedagogy for the education system in Namibia requires learners to construct their knowledge during the lesson. This can only be achieved if teachers build from IK of learners during their lessons. Interestingly, many African countries have ignored the inclusion of IK in science classroom, this make the teaching and learning more difficult by not starting where the learners is and build on what they know already (Kibiringe & Van Rooyen, 2006).

Should you need further information, do not hesitate to contact me on the above mentioned number. I do hope that my request will receive your consideration and looking forward to your prompt response.

Faithfully yours

....

Fredrick Simataa Simasiku (Rhodes university student)

MINISTRY OF EDUCATION,
ARTS & CULTURE
THE PRINCIPAL OFFICE
1? JUN 2015
ONEPANDAULO COMBINED SCHOOL
P.O. BOX 157 OSHAKATI
TEL: 065-225072 FAX2MAIL: 08?5552121
EMAIL: onepandaulo@gmail.com
ENDOLA CIRCUIT

APPENDIX B: REPLY FROM THE DIRECTOR OF EDUCATION

OHANGWENA REGIONAL COUNCIL
DIRECTORATE OF EDUCATION, ARTS AND CULTURE
DIRECTOR'S OFFICE

1st Floor Greenwell Complex Private Bag 88005 Eenhana Tel: 065 – 290 201 Fax: 065 -290 224

Enquiries: Magano Gaoses
Email: mcnotto@yahoo.com

3 August 2015

Mr. Frederick Simasiku
Onepandaulo CS
wadingha@gmail.com

Dear Mr. Simasiku,

Subject: Approval to carry out Educational Research at Schools in Ohangwena Region.

1. Receipt of your letter on the above subject matter is hereby acknowledged.

2. Permission is granted for you to carry out the research on **"Exploring grade 9 Physical Science teachers' perceptions and experiences on the inclusion of Indigenous Knowledge (IK) in their lessons in Ohangwena Region"**.

3. As this is directly involving the teachers, it will be appreciated that your research does interfere with the teaching and learning process.

4. This office hereby wishes you the best in your research and salutes you for the initiative you have taken to go through with the study.

5. Kindly liaise with the Inspector of Education and Principals of schools concerned to be able to come to a conclusion of how best to do the research.

Yours Sincerely,

03/08/2015

Isak Hamatwi
Acting Director: MEAC

Cc: Inspectors of Education

APPENDIX C: LETTER TO THE INSPECTOER OF EDUCATION

REPUBLIC OF NAMIBIA

MINISTRY OF EDUCATION ART & CULTURE: OHANGWENA REGION

Circuit: Endola **Cluster: Shituwa**

ONEPANDAULO COMBINED SCHOOL

P. O. Box 157
OSHAKATI
NAMIBIA

Tel: (065) 225072
Fax: 065 225187/0886552121

20 January 2016

Enquiries: Mr. Fredrick Simasiku @ 0811284219
E-mail: wadingha@gmail.com
Ref no: 12/3/10/1

Mr. Simon Vaeta
Inspector of Education
Ohangwena Educational Directorate
Endola Circuit

SUBJECT: REQUEST FOR PERMISSION TO CONDUCT EDUCATIONAL RESEARCH IN ENDOLA CIRCUIT, OHANGWENA REGION

I, **Fredrick Simataa Simasiku** student number **13s7222** currently doing a masters in science education with Rhodes University hereby seek permission to carry an educational research in your Circuit. I am currently a second year planning to carry my research as from March 2016. I wrote this letter so early because I still have to attach your response when seeking permission from the principals to help me in delivering questionnaires to and from their schools. I am also humbly requesting you as the Inspector of **Endola circuit** to liaise my questionnaires with schools in your circuit. I still need to inform principal of schools in Endola circuit having grade 8 – 10, since my research will be based at that level.

My research interest is to **exploring grade 9 Physical Science teachers' perceptions and experiences on the inclusion of Indigenous Knowledge (local knowledge) in their lessons in Endola circuit.** The research question was driven by my teaching experience as a physical science teacher in Ohangwena region and the remoteness of the region. I ignored to use IK of learners in my lessons and this motivated me to carry a research and find the solution the problem. Many African country still neglecting the use of IK in schools and depend mostly on the western knowledge which have it anchor on our IK. The teaching pedagogy for the education system in Namibia requires learners to construct their knowledge during the lesson. This can only be achieved if teachers build from IK of learners during their lessons. Interestingly, many African countries have ignored the inclusion of IK in science classroom, this make the teaching and learning more difficult by not starting where the learners is and build on what they know already (Kibiringe & Van Rooyen, 2006).

Should you need further information, do not hesitate to contact me on the above mentioned number. I do hope that my request will receive your consideration and looking forward to your prompt response. Attached to this letter is the respond from the regional director of EAC, Ohangwena region.

Faithfully yours

……………………………

Fredrick Simataa Simasiku

Rhodes university student

ARTS & CULTURE

THE PRINCIPAL OFFICE

JAN 2016

ENDOLA CIRCUIT

Enclosed herein is the letter from the Regional Director authorizing me to carry the research in the Region.

Your support in this regard will be highly appreciated and should you have any query, do not hesitate to contact me at the number above

Yours

……………………………………

Mr. Fredrick S Simasiku

RU Student

APPENDIX E: LETTER TO THE PARTICIPANTS (GRADE 9 PHYSICAL SCIENCE TEACHERS)

RHODES UNIVERSITY

Grahamstown • 6140 • South Africa

EDUCATION DEPARTMENT
Tel: +27 (0) 46 603 8383
Fax: +27 (0) 46 622 8028
PO Box 94, Grahamstown, 6140
E-mail: education@ru.ac.za

01 March 2016

Dear Research Participant

Grade 9 Physical Science Teachers

Endola Circuit

Re: The focus of my study is to explore *grade 9 Physical Science teachers' views and experiences on the inclusion of local knowledge (indigenous knowledge) in their lessons in Endola Circuit of Ohangwena Region: Namibia Case study*

Thank you for agreeing to be a research participant in my study. This letter serve to inform you that your participation in this research must be on voluntarily base not be intimated by anyone or me as a researcher.

The study will be conducted in **two** phases. The **first phase** requires participants to complete a questionnaire and, the **second phase** of the study involves participates that would like to be interview on the same topic on the inclusion of IK in Physical science. Answer the questionnaire the way you understand the question and return it to your principal in order for him/her to take it back to the circuit.

Your participation in this research study is completely voluntary and you can withdraw at any time. The data collected in this study will be published as a Rhodes University half thesis. The identity of each participant and their views or contributions will be treated with a high degree of confidentiality and anonymity. If you wish to continue with me in this research, read the instruction on the questionnaire and follow it.

Sincerely

Fredrick S Simasiku
Rhodes University
MEd in Science Education Student

Dr K. Ngcoza (Supervisor)
Rhodes University

I agree to participate in the research on condition that I can withdraw at any time.

Name..

Signature...

Contact number...

APPENDIX F: QUESTIONNAIRE

Teacher's Questionnaire

I **Fredrick SimataaSimasiku**, student number **13s7222,** doing **Master in Science Education** with Rhodes University,would like to requestall Physical Science teachers in Ohangwena region teaching Grade 9 to take part in my research project by completing the following questionnaire. The focus of my study is to explore*Grade 9 Physical Science teachers' views and experiences on the inclusion of local knowledge (indigenous knowledge) in their lessons in Endola Circuit of Ohangwena Region.*

The information obtained in this questionnaire will be anonymous and your name will not be used. *However, if you are willing for me to interview you, may you kindly contact me using the followingnumber*0811284219 *or sms interview, I will call you back.*

Please answer all the questions as freely and honestly as you wish.

PART A: **Profile ofteachers and schools**

1. School location (tick one)

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

2. Gender

Male	**Female**

3. Ethnicity (tick the correct one)

Kwanyama	**Ndonga**	**Herero**	**Zambezian**	**Ngadjera**	**Others**

4. Qualifications (tick the qualifications you have)

ECP	**BETD**	**ACE/FDE/ MASTEP**	**HONS**	**MEd**	**PHD**	**Other**

5. Teaching Experience in Physical Science Grade 9 and total teaching experience?

Teaching experience in Physical Science Grade 9	**Total teaching experience**

6. Age group (Tick one box)

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

PART B: Teachers' views and experiences

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

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2. What are your **views** on the inclusion of local knowledge (indigenous knowledge) during Physical Science lessons in Grade 9?

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3. What factors do you think influence your views on the inclusion of local knowledge (indigenous knowledge) during Physical Science lessons in Grade 9?

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4. What are your **experiences** of local knowledge (indigenous knowledge)that might relate to western or scientific ideas or processes?

(a) At your home?

……
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(b) In your community?

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(c) At your school

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……

5. Describe any local knowledge (indigenous knowledge) you have been exposed to at your home/community that has a process or facts about:

(a) Farming production?
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……..

(b) Medicine?
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(c) Brewing of homemade drinks or beers?
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(d) Building?
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(e) Predicting Weather or Rain?
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(f) Lightning?
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(g) Others?
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6. What were your past**experiences** on the inclusion of local knowledge (indigenous knowledge) during Physical Science 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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……

7. As a Physical Science teacher, have you ever used local knowledge (indigenous knowledge)in your teaching?

YES	**NO**

(a) If **YES**, what was the topic or what were the topics that you used local knowledge (indigenous knowledge) in?

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……

(b) Explain how you used the local knowledge (indigenous knowledge) in teaching the topic or topics?

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(c) If **NO**, what could be the reasons why you never used local knowledge (indigenous knowledge) during your science lessons?

……
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d) In which **topics** do you think local knowledge (indigenous knowledge) can be easily used?

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e) How could local knowledge (indigenous knowledge) be used in some of these topics; can you please give details of how you could use it in a particular topics in teaching Physical Science lesson?

……
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……

8. What do you think what could be the reasons why **<u>other</u>** Grade 9 Physical Science teachers

(a) Includelocal knowledge (indigenous knowledge) during their Physical Science lessons?

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……
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……

(b) Do **not** include local knowledge (indigenousknowledge) in their Physical Science lessons?

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9. Is there any statement in the curriculum/syllabus that promotes the use of LK/IK in Grade 9 Physical Science?………………………………………………………………………………………
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10. (a) What do you think could be the **<u>advantages</u>** of including local knowledge (indigenous knowledge) in Physical Science lessons?

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(c) What do you think could be the **<u>disadvantages</u>** of includinglocal knowledge (indigenous knowledge)in Physical Sciences lessons?

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11. Do you think local knowledge (indigenous knowledge) should be included in Grade 9 or not? (tick in each statements for your choice)

Statements	**Strongly Agree**	**Agree**	**Not sure**	**Disagree**	**Strongly Disagree**
Curriculum					
Syllabus					
Textbooks					

Lessons plans					
Lesson delivery					
Practical work/Activities					
Tests/Examinations					
General discussion					

Part C (usage of indigenous knowledge in Physical Science lesson)

12. Which of the following instructional methods do you consider to be critical for including indigenous knowledge in Physical Science?

Tick the ***six most critical(Top six)***instructional methods for inclusionIK into Physical Science in the 3rd column, then r***ank*** them in the 4th column from the most critical = 1 to the least critical = 6.

Item	Instructional methods for integrating science and indigenous knowledge	Top ten	Rank
11.1	Using a holistic or an integrated instructional approach.		
11.2	Using as much as possible concrete materials to illustrate concepts or principles.		
11.3	Emphasizing ‘showing’ or modeling rather than lecturing.		
11.4	Involving learners actively in problem-solving activities.		
11.5	Starting lessons with learners’ ideas before presenting the scientific view.		
11.6	Extending science classroom discussions to include the IK modes of inquiry, e.g. inviting IK experts into class on some topics.		
11.7	Clarify that indigenous knowledge can co-exist with science that it should not be replaced by it, and has not been replaced by it.		
11.8	Assess each knowledge claim with its own assumptions and standards rather than using science to judge indigenous knowledge as true or false.		
11.9	Teach science using ways that are also used to teach indigenous knowledge e.g. informal conversation and learning through observation and imitation.		
11.10	Making lesson people oriented rather than information oriented.		
11.11	Emphasize cooperative learning rather than competitive leaning.		
11.12	Provide learners ample opportunities to investigate and present their findings.		

13. Explain the choice you have made as to why they are more critical than the others?

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14. What else would you like to share with me regarding the inclusion of local knowledge (indigenous knowledge) during Physical Science lessons in grade 9?

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

APPENDIX G: FILLED QUESTIONNAIERE FOR T_1Q_1F

T_1Q_1F

TEACHER'S QUESTIONNAIRE

I **Fredrick Simataa Simasiku**, student number **13s7222**, doing **Master in Science Education** with Rhodes University,would like to requestall Physical Science teachers in Endola circuit teaching Grade 9 to take part in my research project by completing the following questionnaire. The focus of my study is to explore *Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) in their lessons in Endola Circuit of Ohangwena Region.*

The information obtained in this questionnaire will be anonymous and your name will not be used. *However, if you are willing for me to interview and observed your lesson on how you include local knowldge, may you kindly contact me using the following number* **0811284219** *or sms interview, I will call you back.* If the space provided is not enough; feel at liberty to use a separate sheets or papers

Please answer all the questions as freely and honestly as you wish.

PART A: Profile ofteachers and schools

1. School location (tick one)

Urban	Rural	Semi-urban	Semi-Rural
	✓		

2. Gender

Male	Female
	✓

3. Ethnicity (tick the correct one)

Kwanyama	Ndonga	Herero	Zambezian	Ngadjera	Others
✓					

4. Qualifications (tick the qualifications you have)

ECP	BETD	ACE/FDE/ MASTEP	HONS	MEd	PHD	Other
	✓					

5. Teaching Experience in Physical Science Grade 9 and total teaching experience?

Teaching experience in Physical Science Grade 9	Total teaching experience
3 years	12 years

6. Age group (Tick one box)

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

1

PART B: Teachers' views and experiences

1. What do you understand by the term local/traditional knowledge (indigenous knowledge)?

In my views, Indigenous Knowledge means the practices and contents of a certain subject that are known and applied by the people in a certain environment where the teaching of the subject took place.

2. What are your **views** on the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in grade 9?

I think it is important to include local knowledge in teaching P/science lessons in grade 9 because this help learners to relate what they know to what they do not know. This will help them to understand better. By including local knowledge will also give opportunity to parents to help their children in the subject.

3. What factors do you think influence your views on the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in grade 9?

- ~~Lack of teach~~ Materials available. Some times the materials are not available.
- Limited time
- Lack of experience on a certain ~~Sub~~ Subject content

4. What are your **experiences** of local/traditional knowledge (indigenous knowledge)that might relate to western or scientific ideas or processes?

(a) At your home?

1. The processes of producing a vambo liquor can be related to fractional distillation method in physical science as a method for separating mixture.
2. ~~Making the indicator~~ 2. Use home made substances and classify them as acids or bases e.g. Sour milk, Oshikundu etc. But not only the laboratory substances.

(b) In your community?

Looking at real life local examples of
1. static electricity eg sparks produced by touching some materials
2. Combustion e.g. burning fire wood
3. Physical change e.g. melting fat
4. fermentation e.g. making oshikundu (traditional beer).

(c) At your school

Making indicators by using plant material such as red cabbage, beetroot and red flowers ~~to make~~ that can be used as a universal indicator to indicate whether a substance is acid or alkali.

2

5. Describe any local/traditional knowledge (indigenous knowledge) you have been exposed to at your home/community that has a process or facts about:

(a) Farming production?

No experience on that.

(b) Medicine?

Using herbs such as tomato leaves or Mahangu powder known as ogshundu to heal a chronic cough. Those materials are applied in the large intestine at the back.

(c) Brewing of homemade drinks or beers?

The process of making oshikundu. Mahangu meal is mixed with hot water and then sorghum meal is also added. The mixture is then diluted with cold water. The mixture is covered and left for one or two days. After that it will start to produce bubbles which is an indication of carbon dioxide produced from carbohydrates from meals.

(d) Building?

Making bricks and thatching.
We normally use clay sand to make bricks for building sleeping rooms and cut grasses and use them as thatching.

(e) Predicting Weather or Rain?

I have never exposed to this.

(f) Lightning?

Running during rain or hiding under the tree can cause any one to be strucked by lightning. Wearing red clothing can cause one to be struck by lightning. Those are the stories told by elders but not confirmed if it is true.

(g) Others?

3

6. What were your past **experiences** on the inclusion of local/traditional knowledge (indigenous knowledge) duringPhysical Science lessons?

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

- Evaporation processes related to when over cooking meat all of the water disappear

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

Observed how electricity is produced by facing moving water at Khaeang power station

7. As a Physical Science teacher, have you ever used local/traditional knowledge (indigenous knowledge)in your teaching?

YES	NO
V	

(a) If **YES**, what was the topic or what were the topics that you used local/traditional knowledge (indigenous knowledge) in?

- Combustion
- physical and chemical change
- Acid, bases (alkalis)

(b) Explain how you used the local/traditional knowledge (indigenous knowledge) in teaching the topic or topics?

- In combustion I demonstrated combustion with lighting and a matchstick.
- In physical and chemical change I ~~gave~~ demonstrated examples such as burning ~~wood~~, melting fat, cooking and drying clothes. In I gave examples of acids and bases found in our environment

(c) If **NO**, what could be the reasons why you never used local/traditional knowledge (indigenous knowledge) during your science lessons?

d) In which **topics** do you think local/traditional knowledge (indigenous knowledge) can be easily used?

1. Building blocks of matter
2. Acids and bases
3. physical change and chemical change

4

e) How could local/traditional knowledge (indigenous knowledge) be used in some of these topics? Could you please give details of how you could use it in a particular topic in teaching Physical Science lessons?

1. In building blocks of matter ~~bricks~~ bricks cam be compared to ~~atoms the~~ to compounds that are made up of sand ad cements that can be compared to atoms.
2. Give examples of substances found at home or local as acids or bases so that learners can~~d~~ underst what is acid ad what is a base. Use local examples to demonstrate physical ad chemical change

8. Is there any statement that promotes the use of local/traditional knowledge (indigenous knowledge) in the Grade 9 Physical Sciencecurriculum/syllabus?

Yes. This is when the syllabus needs ~~the~~ everyday examples to be given in a specific topic

9. What do you think what could be the reasons why **other** Grade 9 Physical Science teachers

(a) **Include** local/traditional knowledge (indigenous knowledge) during their Physical Science lessons?

They ~~have~~ are indigenous and they know the local / tradition of the people in such specific environment

(b) Do **not include** local/traditional knowledge (indigenous knowledge) in their Physical Science lessons?

They do not know very well the traditions of the learners they a teaching. Or they ~~do~~ are not exposed to local knowledge.

10. (a) What do you think could be the **advantages** of including local/traditional knowledge (indigenous knowledge) in Physical Science lessons?

1. It help's learners to relate what they know to what the do not know ad make the understand better.

2.

(c) What do you think could be the **disadvantages** of includinglocal/traditional knowledge (indigenous knowledge)inPhysical Sciences lessons?

If some of the learners are not from the local environment it might be difficul for them to understand

5

11. Do you think local/traditional knowledge (indigenous knowledge) should be included in Grade 9 or not? (tick in each statements for your choice)

Statements	**Strongly Agree**	**Agree**	**Not sure**	**Disagree**	**Strongly Disagree**
Curriculum		✓			
Syllabus		✓			
Textbooks		✓			
Lessons plans	✓				
Lesson delivery	✓				
Practical work/Activities				✓	
Tests/Examinations				✓	
General discussion		✓			

Part C: Usage of indigenous knowledge in Physical Science lessons

12. Which of the following instructional methods do you consider to be critical for including local/traditional knowledge (indigenous knowledge) in Physical Science lessons?

Tick the ***six most critical(Top six)***instructional methods for the inclusion of IK into Physical Science lessons in the 3rd column. Thereafter, r***ank*** them in the 4th column from the most critical = 1 to the least critical = 6.

Item	**Instructional methods for integrating science and indigenous knowledge**	**Top six**	**Rank**
11.1	Using a holistic or an integrated instructional approach.	✓	4
11.2	Using as much as possible concrete materials to illustrate concepts or principles.	✓	6
11.3	Emphasizing 'showing' or modeling rather than lecturing.	✓	3
11.4	Involving learners actively in problem-solving activities.	✓	5
11.5	Starting lessons with learners' ideas before presenting the scientific view.	✓	2
11.6	Extending science classroom discussions to include the IK modes of inquiry, e.g. inviting IK experts into class on some topics.	✓	1
11.7	Clarify that indigenous knowledge can co-exist with science that it should not be replaced by it, and has not been replaced by it.		

11.8	Assess each knowledge claim with its own assumptions and standards rather than using science to judge indigenous knowledge as true or false.		
11.9	Teach science using ways that are also used to teach indigenous knowledge e.g. informal conversation and learning through observation and imitation.		
11.10	Making lesson people oriented rather than information oriented.		
11.11	Emphasize cooperative learning rather than competitive leaning.		
11.12	Provide learners ample opportunities to investigate and present their findings.		

13. Explain the choice you have made as to why these instructional methods are more critical than the others?

They are more critical because they need a lot of preparation for example finding models and concrete materials it needs time. The time allocated to the lessons is also limited so it is not easy to extend lessons to include indigenous ~~lesso~~ knowledge in lessons.

14. **General comments**: What else would you like to share with me regarding the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in Grade 9?

I think for the teachers to include indigenous knowledge in their lessons better they need to work hand in hand with elders in the community so that they can explain and demonstrate to the learners.

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

APPENDIX G: FILLED QUESTIONNAIRE FOR T_8Q_8M

T8Q8M

TEACHER'S QUESTIONNAIRE

I **Fredrick Simataa Simasiku**, student number **13s7222**, doing **Master in Science Education** with Rhodes University,would like to requestall Physical Science teachers in Endola circuit teaching Grade 9 to take part in my research project by completing the following questionnaire. The focus of my study is to explore *Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) in their lessons in Endola Circuit of Ohangwena Region.*

The information obtained in this questionnaire will be anonymous and your name will not be used. *However, if you are willing for me to interview and observed your lesson on how you include local knowldge, may you kindly contact me using the following number* **0811284219** *or sms interview, I will call you back.* If the space provided is not enough; feel at liberty to use a separate sheets or papers

Please answer all the questions as freely and honestly as you wish.

PART A: Profile ofteachers and schools

1. School location (tick one)

Urban	Rurai	Semi-urban	Semi-Rural
	✓		

2. Gender

Male	Female
✓	

3. Ethnicity (tick the correct one)

Kwanyama	Ndonga	Herero	Zambezian	Ngadjera	Others
✓					

4. Qualifications (tick the qualifications you have)

ECP	BETD	ACE/FDE/ MASTEP	HONS	MEd	PHD	Other
	✓					

5. Teaching Experience in Physical Science Grade 9 and total teaching experience?

Teaching experience in Physical Science Grade 9	Total teaching experience
	6 years

6. Age group (Tick one box)

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

1

PART B: Teachers' views and experiences

1. What do you understand by the term local/traditional knowledge (indigenous knowledge)?

This is the knowledge that is unique to a Culture or Society around the world, it developed from experience gained over the Centuries and adapted to the local Culture.

2. What are your **views** on the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in grade 9?

The inclusion of local knowledge with Physical Science lessons prevent a cultural divert when the student or learners are learning the meaningful Physical Science.

3. What factors do you think influence your views on the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in grade 9?

1. Race, ethnicity and home environment - this is because Science exists in a Cultural Context this is why non-Western learners struggle with Physical Science.
2. Societal expectations, backgrounds and Customs may influence the inclusion of local Knowledge as Some of those of indigenouse may not go in one line with that of Physical Sc.

4. What are your **experiences** of local/traditional knowledge (indigenous knowledge)that might relate to western or scientific ideas or processes?

(a) At your home?

1. Cooking - local knowledge ideas of Cooking are all the same as those of western ideas.
2. Spacing of food - the ideas of making food taste by using local knowledge and western ideas is the same.

(b) In your community?

Traditional healers use local knowledge to treat people on different diseases which is the same as the ideas of western Culture. Indigenous people use their local knowledge to Cultivate their crops which is the same of the western.

(c) At your school

2

5. Describe any local/traditional knowledge (indigenous knowledge) you have been exposed to at your home/community that has a process or facts about:

(a) Farming production?

The use of ridging techniques where by the farmer form a continuous lump of elevated soil mound during cultivation. So the western use this techniques and further developed them to assist in checking soil erosion and conservation of water.

(b) Medicine?

The African potato for example has traditionally used for its many medical properties. Traditional healers used it to treat cancer. So the western ideas developed a medicine that enhances the body's natural defence system.

(c) Brewing of homemade drinks or beers?

Africans use the Mahangu/maize meal to make their home drinks since the natural sugar in it make it to rise. The westerns use this ideas of natural sugar and developed it into the study of fermentation process and the study of yeast that enhance fermentation (enzyme).

(d) Building?

(e) Predicting Weather or Rain?

Farmers used or have been using combination of various biological, meteorological and astronomical indicators to predict the rainfall such as wind flow, temperature changes etc. and this goes in line with the scientific one.

(f) Lightning?

The old people or even current local people use the local knowledge that the visit of Scopus umbretta bird at home homestead is associated with strike by lightning in that homestead.

(g) Others?

3

6. What were your past **experiences** on the inclusion of local/traditional knowledge (indigenous knowledge) duringPhysical Science lessons?

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

The use of traditional herbs when having a stomach ache was one of my past experience which will act as a base to neutralise acid produced in the stomach which led to the development of eno.

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

One of my past experienced at university was fire making, indigenous people use sticks to make fire which was scientifically developed to a match making in a sense that friction can produce fire.

7. As a Physical Science teacher, have you ever used local/traditional knowledge (indigenous knowledge)in your teaching?

YES	NO
✓	

(a) If **YES**, what was the topic or what were the topics that you used local/traditional knowledge (indigenous knowledge) in?

- Friction
- Acid and Bases

(b) Explain how you used the local/traditional knowledge (indigenous knowledge) in teaching the topic or topics?

* I use Friction which has been used in fire making by using two stick which then lead to a development of match box and stick. * The use of traditional herbs to treat stomach ache which lead to development of eno, all of this I use them as examples referred to traditional knowledge.

(c) If **NO**, what could be the reasons why you never used local/traditional knowledge (indigenous knowledge) during your science lessons?

d) In which **topics** do you think local/traditional knowledge (indigenous knowledge) can be easily used?

Acid and Bases.

4

e) How could local/traditional knowledge (indigenous knowledge) be used in some of these topics? Could you please give details of how you could use it in a particular topic in teaching Physical Science lessons?

Local knowledge can be used in this topics by giving relevent examples based on daily life which has to do with treatment and neutralizing of poisonous things.

8. Is there any statement that promotes the use of local/traditional knowledge (indigenous knowledge) in the Grade 9 Physical Sciencecurriculum/syllabus?

....

9. What do you think what could be the reasons why **other** Grade 9 Physical Science teachers
(a) **Include** local/traditional knowledge (indigenous knowledge) during their Physical Science lessons?

This is because this make things easy for the learners as the examples of local knowledge relates the scientific ideas to some of the prior knowledge of learners which make it easy for learners to understand.

(b) Do **not include** local/traditional knowledge (indigenous knowledge) in their Physical Science lessons?

- Traditional knowledge do not always fit in every topic in Physical Science.
- Traditional knowledge are not known well by the teachers since when they were trained, they were not trained about these.

10. (a) What do you think could be the **advantages** of including local/traditional knowledge (indigenous knowledge) in Physical Science lessons?

- It relate the concept to what pupils already knew.
- It make the lesson more interesting and all pupils will pay more attention.

(c) What do you think could be the **disadvantages** of includinglocal/traditional knowledge (indigenous knowledge)inPhysical Sciences lessons?

....

5

11. Do you think local/traditional knowledge (indigenous knowledge) should be included in Grade 9 or not? (tick in each statements for your choice)

Statements	**Strongly Agree**	**Agree**	**Not sure**	**Disagree**	**Strongly Disagree**
Curriculum	✓				
Syllabus		✓			
Textbooks		✓			
Lessons plans			✓		
Lesson delivery		✓			
Practical work/Activities				✓	
Tests/Examinations		✓			
General discussion	✓				

Part C: Usage of indigenous knowledge in Physical Science lessons

12. Which of the following instructional methods do you consider to be critical for including local/traditional knowledge (indigenous knowledge) in Physical Science lessons?

Tick the ***six most critical(Top six)***instructional methods for the inclusion of IK into Physical Science lessons in the 3rd column. Thereafter, r***ank*** them in the 4th column from the most critical = 1 to the least critical = 6.

Item	**Instructional methods for integrating science and indigenous knowledge**	**Top six**	**Rank**
11.1	Using a holistic or an integrated instructional approach.	✓	6
11.2	Using as much as possible concrete materials to illustrate concepts or principles.	✓	3
11.3	Emphasizing 'showing' or modeling rather than lecturing.	✓	4
11.4	Involving learners actively in problem-solving activities.	✓	2
11.5	Starting lessons with learners' ideas before presenting the scientific view.	✓	1
11.6	Extending science classroom discussions to include the IK modes of inquiry, e.g. inviting IK experts into class on some topics.		
11.7	Clarify that indigenous knowledge can co-exist with science that it should not be replaced by it, and has not been replaced by it.	✓	5

11.8	Assess each knowledge claim with its own assumptions and standards rather than using science to judge indigenous knowledge as true or false.		
11.9	Teach science using ways that are also used to teach indigenous knowledge e.g. informal conversation and learning through observation and imitation.		
11.10	Making lesson people oriented rather than information oriented.		
11.11	Emphasize cooperative learning rather than competitive leaning.		
11.12	Provide learners ample opportunities to investigate and present their findings.		

13. Explain the choice you have made as to why these instructional methods are more critical than the others?

The are more Critical in Such a way that learners will learn and understand better if they are more involved in problem solving. Using modelling rather lecturing will help learners to integrate the theory with the practical.

14. **General comments**: What else would you like to share with me regarding the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in Grade 9?

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

APPENDIX H: SEMI-STRUCTURED INTERVIEW QUESTIONS

SEMI-STRUCTURED INTERVIEW

1. For how long have you been teaching experience in Physical Science?
2. What do you find interesting/useful/ fascinating about the teaching and learning of Physical Science?
3. Could you please tell me about your experiences of being taught Physical Science at school?
4. What do you understand by the term traditional/local knowledge (indigenous knowledge)?
5. What are your views on the inclusion of traditional/local knowledge (indigenous knowledge) during Physical Science lessons in Grade 9?
6. In which topics do you think traditional/local knowledge (indigenous knowledge) can be incorporated in the Physical Science?
7. Have you had an opportunity to include traditional/local knowledge (indigenous knowledge) in your Physical Science lessons? If so, could you talk about the examples that you used and how?
8. What are some of the challenges/difficulties on the inclusion of traditional/local knowledge (indigenous knowledge) did you experience in your science lessons?
9. What do you think what could be the reasons why some Physical Science teachers incorporate traditional/local knowledge (indigenous knowledge) in their lessons and yet some do not?
10. Describe any local knowledge (indigenous knowledge) you have been exposed to at your home/community that you think can be used in Physical Science lessons?

APPENDIX I: RESPONSE FROM T_1SSIM

Teacher one Semi-structured interview Male (T_1SSIM)

Interview with Mr. S teaching Physical science Grade 9 & 11 at school A

Me: ok, Mr. S (name of the teacher) good afternoon

Mr. S: Good afternoon sir

Me: How are you?

Mr. S: Fine thanks and how are you sir

Me: I am fine, my name is Fredrick Simasiku am a student who is doing a masters in Physical Science, so am doing a research, my research is basically on the inclusion of indigenous knowledge (IK) in Physical Science so am trying to look at how can we incorporate local knowledge that the learners has from home in to our lessons, so am specifically on grade 9 Physical science, so this research eee after the results basically your name will not appear there, what will appear there I will use eee I will use a different name that it may not affect your image that may not either affect the image of the school, so I will use the synonym not your real name, here I might call your name but in the research itself your name will not appear there, so I have very very few questions that I would like you to respond to, so you have to feel free, this is just a research and I hope one of the day you will go through the same process.

Mr. S: Jaaa

Me: so my first question, I would like to know which subjects do you teach?

Mr. S: am teaching Physical Science grade 9 and Physical science grade 11

Me: so you are teaching Physical science grade 9 and Physical science grade 10, so for how long you have been teaching these subjects?

Mr. S: eee it's for six (6) years now

Me: woo you have such a good experience in teaching these subjects

Mr. S: jaa since I started teaching at this school I have been teaching Physical Science

Me: ok, so during your teaching experiences, what did you find fascinating in teaching, what did you find interesting in teaching Physical Science

Mr. S: eee Physical Science is eee, is a very interesting subject so in most topics it have the facts that can be proven by doing experiments, they are some other things that can be even proven by things that we see in the everyday life

Me: ok

Mr. S: which is more interesting

Me: so it means now eee by teaching Physical Science they are thing that we can see in our real life situation

Mr. S: jaa thing that we can see

Me: ok, so as a learner, you were also a learner at certain time, how did you find, how is your **experience when you were taught Physical Science**, it's the same on how you are teaching Physical Science or it's different?

Mr. S: eee normal this thing may depend to a teach who is teaching you, maybe at school where you have being taught

Me: ok

Mr. S: but they are nothing more differ, there is no that big difference on how we were taught, its only that now there are so many experiments that can we do

Me: that can be done

Mr. S: that can be done

Me: than before

Mr. S: than before, because before let say maybe the materials for carrying out the experiments were not eee

Me: were not available

Mr. S: were not available, so the teacher will be more only referring to some simple examples that maybe can be seen even in the environment

Me: ok

Mr. S: something is happening and so on

Me: ok, so now as a teacher you have that experience also, can you briefly tell me your experience in teaching this subject Physical, how do you find it?

Mr. S: eee, uhhh teaching Physical science its, it's a very good thing; it's a very good subject to teach because it makes you to have that thing of wanting to know more things

Me: to explore more

Mr. S: to explore more different things, as eee some of the things let say the process that are used let say in some industries, they maybe also be similar to those that are happening at our house or at our home, maybe let say we are cooking

Me: uhhh

Mr. S: cooking, let say you are cooking the meat and that thing (cooking) it's just brought up by ideas of heat, that is make the what? making the the the the what? the thing that you are trying to cook, let say too expand

Me: uhhh

Mr. S: let say we a boiling water, water expand and even the what, even the pot itself expand caused by the heat, it's also being done in the experiments in a what?

Me: Physical Science

Mr. S: in Physical Science

Me: in a classroom situation

Mr. S: jaaa, that when you heating something, like when you are cooking the pot itself has to expand, that is what we also do in the experiment there when we get a ball and a ring, it feats in a what? in a ring

Me: before it expand

Mr. S: before expand but after heating, so the whole things here it just about the heat and they are more more

Me: experiments or examples

Mr. S: jaa, jaa they are more other experiments or example that you can relate to the what? to the real life situation

Me: ok, now, now we are trying to link the subject contents with the local contents, now if I may ask could you please tell me how do **you understand by the word local or indigenous knowledge**?

Mr. S: eee, local or indigenous knowledge I believe this is knowledge that let say people has before, the knowledge that they acquired maybe just from the environment where they are living because you find some people did not go to school, they they are not taught, they are not been taught Physical science or any other subjects, but you find that they have a knowledge, let say like the meekulus (Old Meme) and tatekulus (Old tate) they make a liquor that they use to drink.

Me: it means that liquor

Mr. S: that liquor

Me: is part of the indigenous knowledge that they have in that community

Mr. S: yes (loud voice with a smile) it the part

Me: ok

Mr. S; because they mostly likely they celebrate, when they are celebrating liquor, that traditional liquor or maybe the traditional beer, it's what they use when they are gathering, when they have gathered when they are having ceremonies or soo

Me: uhhh

Mr. S: and that knowledge can be used by someone who is in school

Me: ok

Mr. S: for example if the person is studying eee, eee this topic like eee, distillation

Me: Fractional distillation

Mr. S. jaa, so that is the knowledge that they have from home, when they come to school or maybe doing this practical, they link that, that thing (knowledge) that sample, that topic to the thing that they have seen eee, eee at the village

Me: ok, so that is fascinating to hear that when the community they have this indigenous knowledge, this indigenous knowledge can be link to what is taught in the classroom, you gave example on the topic of distillation when they are making traditional beer, it also the some process that learner are taught in the classroom

Mr. S. in the classroom

Me: ok, while we talking about the inclusion of indigenous knowledge, different people have different **views on the inclusion of this indigenous knowledge during Physical Science**, what are your views on this inclusion of indigenous knowledge, do you think it's applicable or not?

Mr. S: eee, in Physical Science eee this indigenous knowledge it may be difficult to apply but its need to be applied where is possible. What makes it difficult is that maybe they are only some few topics where one can includes this eee

Me: indigenous knowledge

Mr. S: indigenous knowledge eee for example if I may to mention few examples, I think the very topics that one can include the indigenous knowledge it's, that is the topics that include some processes

Me: where you have to do some experiments

Mr. S: where you have to do experiments

Me: apart from the experiments

Mr. S: eee, apart from experiments you may just include it maybe by, by giving examples, eee let say you are teaching maybe a topic on eee, let say a on a force, let say friction. Our tatekulus' and mekulus; have that ideas that if two objects are maybe touching each other it may cause, may cause heat between them and they used the what? the fat from what they get from the milk of the animals to rubricate them

Me: ok

Mr. S: just to make sure that if the objects are to be crushed (rubbed) together they don't damaged

Me: ok, that is very interesting that eee, they are topics that where indigenous knowledge can be included and topics that indigenous knowledge cannot be included, now you gave example on the topic on **friction**, now in Physical Science lesson. how can you incorporate this two, the knowledge or the contents of the subject and the friction or the knowledge that we get from home, how can we incorporate this two, so that the learners will have a better understanding of what you are teaching is what they know from home, how can you use this knowledge from home to teach Physical science on that topic of friction

Mr. S: eee on friction, let say if I may to explain on friction, on the content in the book what so ever and syllabus or so, learners are being taught that friction is the force that acts on the opposite direction to the moving objects but eee let say when they are, they are, let say when they are, they have, they have to unlock a certain nuts which is (pause)

Me: tightened

Mr. S: tightened eee for this learner if, if the learner have to unlock that, there is a need to, let say oil like grease to be applied on that

Me: to be applied on the

Mr. S: so that it make easier for the unlocking of the nut, but the learner can only use that using eee that knowledge from, let say from home when they are, let say when they are, even having the, the what? they when the parents are making those skinned to be (giving action with the hand)

Me: to softened

Mr. S: to be softened, to be softened they also apply that, when they are doing that the skin have to be what? (showing action by using hands) to be soft, for a learner, if the learner have that idea one can have the clear picture that, yes the applying of what? of the oil or what so ever (pause)

Me: to make it to be soft

Mr. S: Something or it makes work to be easy, so that is an example one can give when teaching this topic so that learner can find out, at home or the people is also learning that idea that how friction works. The other things is when they are making fire, this idea of friction they sticks to do this (demonstrating with hands) if the keeps on doing that, when they are doing that the friction their it become hot, this is the some idea that we are using when we are lighting a matches

Me: now, because I use to see when I was still growing that if there is no matches in the house they will look for the old stick and they look for another new stick which is dry, then they will dig a simple hole, so now that can you explain more how come that we can apply that one, that knowledge in the classroom situation

Mr. S: so eee

Me: that friction

Mr. S: that friction

Me: for the learner how to get it from there into the classroom situation

Mr. S: for that now, if the learner have seen someone doing that eee maybe he or she have seen that fire have happened when someone is doing that

Me: like in my example I have seen that

Mr. S: like you who have seen that, then that means friction can cause fire or it can cause thing to be worn, the learner by having that idea that when it come to the classroom situation will have that idea that if am to, let say if am to move a box from one place to another, I don't need to pull it on the floor since the, the what? the surface are not that smooth because it may cause damage on the, damage on the box which is not needed

Me: ok, so now that how you have to link the topic on friction

Mr. S: link friction, jaa

Me: apart from that topic on friction is there any other topic where indigenous knowledge can be applied

Mr. S: eee in a Physical Science they are other topics like acid and bases

Me: so, acid and bases now it a topic in Physical Science, how can you teach acid and base to link it to the knowledge of learners from home, example you can give

Mr. S: at home, let say your sting by, by a bee people taking some leaves, let say they chew it and have to apply it where the bee stings you, meaning that when that leaves now have been applied there, the pain or so reduced, this is explaining that maybe the leaves has reacted with what the bee have injected in the person thing which could be an acid and maybe the leaves to act as the base to neutralize the acid on the skin and this will go in line with what teachers explain when they trying to neutralize something on the laboratory, even when they are explaining the use of Eno, when the person has the stomach pain, stomach pain then that there is too much hydrochloric acid in the stomach and what is to take the Eno so that it neutralize the acid

Me: now is Eno the base or acid also

Mr. S: which means Eno

Me: now it will neutralize

Mr. S: the hydrochloric acid which is in the stomach

Me: ok, still there on the base and acid do you have any other example apart from that one of a bee, something that maybe the learners they have the knowledge from home, that might, they come at school they know that this one, they might know it but they don't know whether is acid or base

Mr. S: eee, learners may have this, may have also come across about why, let say there is eee, this traditional beer that we make in our houses and so on, when it stay too long maybe for two days, it become too much sour and for one to drink it maybe one has to apply sugar or maybe one has to apply water, which is a little bit an idea that there is a kind of something like diluting which is now to reduce that test that it has before

Me: now that sour that the traditional beer or the liquid has is it an acid or a base

Mr. S: if it's now become sour, it's will be like an acid, that why it has to be what? has to be neutralize so that it will test a little different

Me: now I know when we were growing, we use to have this sour milk, is that one also an example of an acid or a base

Mr. S: sour milk, that one that we

Me: we get from the cattle

Mr. S: from the cattle

Me: yes

Mr. S: (pause) when it stay for

Me: for some days then it become little bit thick

Mr. S: (long pause)

Me: ok, if you don't have that experience it's not a problem, now we were on the friction, acid and base any other example that you think or any other topic that you think is in Physical science and it also applicable, we also talked about fractional distillation also when we are making this our traditional beer, can you try to explain more on distillation how can we use this distillation from home into our classroom situation

Mr. S: eee, in our, in our homes people when they are making the liquor or beer whatever it called, which is now made from fermented fruits that will be now a kind of alcohol mixing with water, it's what they try to do when they a making this, it's to make sure that the alcohol is pure taken or separated from what?

Me: from the other content

Mr. S: from the other content and then in a classroom situation, there is a time when, let say you have mixed water and alcohol and so on, but you have to separate them, alcohol from water what you need to do is you have to use that process fractional distillation or so whereby the person will have to make sure that they use the thermometer so that as we know that this, some of this thing they don't boil at one temperature, may be water boils at 100 ^{0}c and then alcohol boils below that 100. So learners they have that ideas or let say the indigenous knowledge those people they have that idea that, how come they separate the what? vambo, vambo what so ever liquor from water maybe because they have that idea that there is one that can maybe boil then, then the other one later.

Me: now, we are talking about this traditional beer which is Ombike

Mr. S: jaa, Ombike

Me: Ombike, it means ombike can be made using distillation and it a good example to be included in the Physical Science lesson

Mr. S. yes

Me: how do the old people knew that for them not to have diluted ombike, because in our classroom we have thermometer, them they were not having the thermometer. How did they knew that from this point to this point is this ombike from that point to that point this it might be diluted ombike, from that point to that point is water

Mr. S: (laughing by smile) I think these people just learned from eee, let say they were also doing practical eee just learnt in the process the the maybe at first they have find out that, when ombike comes out first for some time, the ombike that will come after that it's not that pure, that why may be they get to learn that if I have two containers, on this container I will onlt get a bottle one bottle of pure ombike and maybe the second one will not be that pure. So they have learned from just practicing

Me: now looking at that experience, I know when they are making ombike, earlier you talked about the issue of cooking, the issue of heat when they are making ombike is it the same when we are doing this experiment in the factory and the one when we are doing this experiment or making ombike is it just the same

Mr. S: do you mean the process of making ombike

Me: the issue of the heat, maybe in the factory they control the issue of temperature, we should reduce the temperature so that this process should go on, what about at home do they use to do the same process or what?

Mr. S: this people they also have that idea because there is another container where they use to put cold water and this cold water it's to make sure that the other substances which now coming in the gases state it being cooled

Me: has to condense

Mr. S: it has to condense, then then that why the put cold water in the other container through which there is a what? there is a pipe which is carrying the smoke so that

Me: that pipe which is carrying the smoke so that should condense

Mr. S: should condense and change into the liquid state

Me: which mean indigenous knowledge or local knowledge can be applied in our Physical Science lesson?

Mr. S: yes

Me: looking at this topics fractional distillation, we talked about acid and base and we talked about other topic

Mr. S: friction

Me: friction, now let us come back on acid and base, now we have this different fruits at home, we use to eat them are those, some of those fruits do they have do they contain acid or base for example lemon

Mr. S: eee, different fruits they contain eee acid, its only that the acid now can be classified in few groups let say maybe strong acid and weak acid and so on. Some of the fruits that we eat like lemon it contain acid which maybe refer to it as citric acid

Me: ok

Mr. S: that type of acid, it's also weak because it will also does not even cause harm to our health but they are some that maybe they may be contain that strong acid which maybe if one consume it the health may be disturbed, so

Me: maybe you want to add something

Mr. S: I wanted to say that they are some fruit that are not eatable at all, cannot be eaten, since maybe they have that strong acid

Me: it means our local people; I know in the environment we have a lot of fruit that a eatable and those not eatable because they use to say if you eat this and that it means indigenous knowledge is already applicable there

Mr. S: it's already applicable

Me: they have seen that if you eat this you can either have running stomach or what what now they have that experience. Ok, so now talking to you I have seen that you have that experience or you had that opportunity where you included indigenous knowledge in your lesson, now looking at the learners now when you bring something from home into the classroom situation, how is the reaction of the learners?

Mr. S: eee, learners sometime they are very interesting because the moment you give examples from just real life situation from the surrounding that when they start saying *ohh jajaja enho mani* (yes yes yes it's true) so, meaning that most of the things they saw them happening out there, it only that maybe they don't whether they can be the apart of what is happening in the classroom situation and that why in most cases where the examples from the surrounding has to be given, should be always be given, so that it make easier for the learner to understand the concepts

Me: to connect what is in the lesson with what is at home

Mr. S: jaaa

Me: so you have been including local knowledge in you lesson they are some of the things that or what are the **factors that you think you as a teacher or should I say the advantages** of including indigenous knowledge in your lesson? is there any advantage

Mr. S: there is a very big, most of this things have good advantage, have benefited the learners, this is because science is something let say first belongs to the western people and so on, but the moment this knowledge, local knowledge is being included this will make work easier for our learners because they are some of the things that you maybe mentioning in the lesson at a school in the village and no one will have the ideas of that

Me: of what you are mentioning

Mr. S: yes, but the person can only get to understand and to know what does the thing mean or does the content mean it only when we can give example from the local knowledge being brought up that when one can open up and understand

Me: now you mean that indigenous knowledge can make the lesson interesting

Mr. S: uhhh

Me: and also it can make the learners to be active

Mr. S: to be active, to understand better the concepts, even to know how to apply something into the real life experience

Me: so, now it means indigenous knowledge have these advantages on the other sides also it might have some **disadvantages**

Mr. S: It might have some disadvantages

Me: when you look into indigenous knowledge do you use to find those disadvantages in your lesson

Mr. S: eee, the disadvantages will only comes when you give an examples which may be dangerous, because some of the examples we give learners may want to try them out then it become bad to give a what? eee, dangerous examples to a learner because a learner will try that out may be it will cause some injuries or any other thing which is not needed

Me: now, what about the issue of concepts in our local language because this indigenous knowledge is more on local language. How do you find that one into real life lesson?

Mr. S: (long pause) thee language

Me: Let say for example when we are making Oshikundu, we have those concepts that we use and when we want to speed up the reaction we talk about catalysis the what what, now in the local language the concepts they are there in English the concepts they are there, now to bring this two concepts together is there friction between the two, let say catalyst and oshipithiso

Mr. S: jaa, eee

Me: are there the some or they are different

Mr. S: they maybe some few difference but the difference will only come maybe with the names but maybe the work that this thing do is just the same, jaa for example if you talk of the catalyst that is just to speed up the reaction and the one to have oshipifilu (oshipithiso) is to make sure that when you put Oshikundu there it will not take that many hours for it to be read but just have to take some few hours. Which means these things are just the some they are only differ by the name or maybe by the work they do.

Me: ok, now as a teacher for Physical Science you also experience some challenges or difficulties on the inclusion of local or indigenous knowledge. Do you have ever **experienced any challenges** when you were incorporating indigenous knowledge or local knowledge in your subjects

Mr. S: yes

Me: what are those challenges?

Mr. S: This challenges sometimes come on the, on the let say on putting this some of this thing on the language that you teach in the subject, Physical Science is quite …. and sometime you may have want to include a certain concept in the what? in lesson but you will not have that …. you don't, you will not know which word must I use in order to explain this clearly to the learners

Me: now we are talking about the issue of concepts that in our language they are not yet that developed, you might have those concepts but we might have that lacking of knowledge

Mr. S: jaa, there is something lacking

Me: what other challenges did you find out?

Mr. S: am the other challenges is now goes with the topics that some topics may not have that good examples, let say by, by their own and if you try to explain them so that you familiarize the learners to what is happening in real life situation you will find it difficult to give an example or to to to to explain it just by using knowledge from home (Local or indigenous knowledge) or from the surrounding. These are the most challenging things, and that will, that will make it difficult for the learners to understand.

Me: what about the issue of textbooks, do they include part of the indigenous knowledge or they just include western side

Mr. S: that is the things now, eee textbooks most of the things there, we can say they knowledge is being included in the textbooks but when they are included in the textbook they are not included as eee as ours because this western people sometimes they copy things from our people (long pause)

Me: and they improve

Mr. S: jaa, when they improve them some of them they are named after them since are the one who developed them or who improved them

Me: concepts

Mr. S: concepts but they have where they have taken them that is the things, so our knowledge is in the textbooks but it appears there as western originated theirs

Me: that is very interesting you came to realize that the knowledge that is in the textbooks some how, some where is link to the knowledge that us as indigenous people have. Those are some of the challenges or do you have other challenge that you have experience

Mr. S: eee, may be I have to say it's the when it's now when again come to the textbook again most of the things given there as an example or that are used to explain a certain topic are only from the developed town and so on, which may now make it difficult for a learner in a what? in a rural school to understand. That is another difficult you may have experience

Me: what about the availability of materials, let say we talk about fractional distillation, now you want to teach that one, how is the availability of that one in the local community, is it available you can take the learners there, for them to see for you to explain, availability of materials there

Mr. S: some of the materials may not be available but as a teacher with your learners you have to improvised, you may come across some of the unwanted things you can use to improvise your own fractional distillation, the only things is only to get eeee let say the thermometer, so when you do it you don't just do it how traditional people are doing

Me: now you are incorporating the western and indigenous knowledge to improve

Mr. S: to improve the understanding of the learners

Me: ok, now, most of the Physical Science teacher or when you decide or when you teaching Physical Science, some of the Physical Science teacher may not even think of include indigenous **knowledge like you, now why do you think other Physical Science teacher apart from you are not including indigenous knowledge?** if I may ask

Mr. S: one maybe eee let say a person or a teacher is not that use to what is happening in the environment

Me: so he is not knowledgeable

Mr. S: he is not knowledgeable

Me: about what is happening in the environment

Mr. S: another thing the teacher may have, may include the indigenous knowledge without him or herself knowing what he is doing

Me: this is linking to what the learners knows already

Mr. S: yes, and maybe, the other why they don't include it maybe they find it boring to them but only if they don't know what is real happening in the what? in the environment

Me: so the find that this knowledge is boring, ok those are some of the reasons why other Physical Science teacher are not including the indigenous knowledge in their lessons. Now we have been talking more about indigenous knowledge apart from the one that we talked about, is there any other indigenous knowledge you think, maybe when we were talking about, when we were discussing something come up then you said ohh this one also it true indigenous knowledge and it's there in the lesson I need to start including it, is there anything that come up during our interview

Mr. S: yes

Me: what is it

Mr. S: when we were discussing on the, on the concepts in notice when we talked of oshipifilu and a catalyst so since I have been teaching Physical Science eee in this kind of topic of Chemical reaction I haven't thought of this using Oshikundu and oshipifilo this things to spend up the reaction

Me: ok that is very interesting, on my last last question, I would like to know in the **Physical Science syllabus** is there any statement that promote the use of local knowledge

Mr. S: (long pause) eee, I will say yes, you know it's not specified but some topic or objectives you find that the objective states that you explain so what what using eee examples from everyday life, when they say everyday life we already include, we are already including the local knowledge

Me: it means our syllabus is giving us that chance to include local knowledge

Mr. S: yes, because when they are saying using everyday life situation that when you have to look in the surrounding what is happening, is there anything that I can use to make this learners understand the things that am teaching, so the syllabus has stated that, that any one need to use this (local knowledge)

Me: own myself when I use to teach Physical science I never also knew that life experience or everyday life its part of IK, so that I have to go back and re-read my syllabus I have to be able to understand. Now I think we have come to the end of our interview, so maybe you have something that you would like to ask me before we conclude

Mr. S: jaa, not real I just want to thank you for choosing me to be your participant in your research, and this was, to me it's a good experience I have gained a lot actually I got a picture what to do also when am to do or further my study and through our discussion I also let some of the things that I will use in the lessons as indigenous knowledge to make the learners understand

Me: so Mr. (name of the teacher) the pleasure is mine because whatever discussion that we have done so far, I learnt a lot about the issue of indigenous knowledge how it can be applicable into our lessons.

Me: thank you very much

Mr. S: it's my pleasure (Shaking of hand)

APPENDIX I: RESPONSE FROM T_2SSIF

Teacher two Semi-structure interview Female (T_2SSIF)

Interview with Meme S teaching Physical science Grade 9 & 10 at school B

Me: Meme S (name of the teacher) my name is Mr. Simasiku a student at Rhodes University I am doing a research or am doing a master's in education and am conducting a research, basically my research is on the inclusion of indigenous knowledge how can we use local knowledge into our Physical Science lessons, and am more on grade 9 how can teachers in Ohangwena region can incorporate indigenous knowledge in their teaching. So I have very very few questions that I would like to ask you so you have to give me some off you time to answer through these questions. The first questions that I would like to ask you is which subject do you teach?

Meme S: uhh, I am teaching Physical Science grade 9 and 10 and Life Science grade 9

Me: ok, for how long you have been teaching Physical Science

Meme: 22 years

Me: 22 years, so have that quite experience, now how did you find the teaching of Physical science is it interesting, fascinating when you are teaching Physical Science how do you use to fill

Meme S: quite well, teaching Physical Science to me is very interesting subject because it deal with local with things which is even around us that we inter-reaction (include) in our teaching

Me: ok, which means you teach Physical Science using the local materials, on now, during before you become a teacher you were a learner also, can you try to recall that experience how did you find when you were taught Physical Science, what is your experience during that time?

Meme S: uhh, jaa it was interesting because I was thinking that I was very fortunate learner because my teacher was so motivated, know the subject knowledge well and he was so even doing practical things with us it was very interesting that why I even get motivated to learn more in physical science

Me: carry on with Physical Science

Meme S: uhh

Me: ok, now you talked about Physical Science more interesting because you use local materials that are available, if I may ask you could you please tell me how do you **understand the term local or indigenous knowledge or traditional knowledge.**

Meme S: jaa, local means thing that you found within the surrounding, within the communities that you can bring in as a real teaching aid and knowledge we also have our fore fathers and other people who is at home using some traditional plants or whatever that they can use either by making tea, whatever you want like medicine that we use in our local that why sometimes when you are teaching we include and we say this is now local instead of this artificial (western) things

Me: now you have also experienced that local people they have their own indigenous knowledge that can be integrated in Physical Science. Ok, now well we are there on local knowledge what are your **views on the inclusion of local knowledge in Physical Science**? Do you like including it whenever you a teaching or you exclude it

Meme S: so I have to include it because they have to start from something that they know that they find in the community then you add to something (western knowledge) that come in, I like to include it I don't want to exclude it because it part of the syllabus

Me: it part of the syllabus

Meme S: uhh

Me: now you are saying that you use to include this indigenous knowledge in your lesson, now if you go through the syllabus for Physical Science grade 9 is there any statement which says we have to include local knowledge

Meme: jaa, in our syllabus their they are stating that learners can also use teaching aid from their locality, therefore it's important that we have to (showing action with hands)

Me: have to include it

Meme S: jaa, so that learners can also be asked to bring them

Me: so that is fascinating to me to see that whenever you are teaching Physical Science they are topic that you have to send learners to bring the materials in the class for to build from what they know. Now while we are the in Physical Science grade 9 is there any **topic that thinks you use to include local knowledge**

Meme S: yes there is a topic called environmental chemistry that deal with acid and base, when we talk about this acid and base is something we also have at home when we are making traditional breweries, when we are making tea we use local things when especially when we are using lemon and others even this sorghum people they can use it to make their tea and other local they are a lot that we have to use

Me: ok, so you talked about **acid and base**, now can you try to clarify more on what aspect do you real use to include that the learners they know from home that they bring and you integrate it into your syllabus

Meme S: jaa, sometimes I do ask them to bring lemon, even traditional Oshikundu, even toothpaste apart from toothpaste they can bring this I don't know how to call it in English

Me: you can call it in our language

Meme S: in our language we call it oshimhumu, a bitter bush that we use to clean our teeth, even the soap that they are even using to bathing their body and clothe its part of the local materials that we use at home

Me: thank you, you talked about Oshikundu am more interested when I hear Oshikundu now, now we are talking about acid and base, and Oshikundu is just traditional liquor or a traditional drink is there an acid or base

Meme S: is an acid

Me: is an acid, it means when you are teaching Physical Science you include Oshikundu as a local knowledge of the learners that they come up or that they have from home, that is interesting. Maybe any other topic that you think you can still use local knowledge apart from environmental chemistry

Meme S: (pause) …. jaaa, sometimes when we are doing this atoms and molecules what we do we ask learners to bring some … like marula fruits or eenyandi fruits then you can use it to build up molecules of water, carbon dioxide and others, you can see that if you have the marula fruits and eenyandi fruits this are different and they can even distinguish between which one is oxygen and which one is tom

Me: ok, now you said you had that opportunity to integrate indigenous knowledge into your lessons, you talked about using of Oshikundu or using of toothpaste or the bush that they use clean their teeth now during the lesson how do you use Oshikundu to teach acid to this learners

Meme S: jaa, oooh in science we have also provided with teaching aid like we are given litmus paper, so you can put Oshikundu in a certain bowl as a kind of a liquid not knowing that it's an acid or a base and you have another soap solution there, we can come up with the litmus paper that normally when you put it in to Oshikundu, acid or base it change colours because they have that theoretical then you have to put it, if I put a blue litmus paper in to an acid what will be the colour change provided that you have that one, then you put it learners can easily identify that ooh Oshikundu is any acid or because it being indicated by the colour change of the litmus paper

Me: ok, that is a very good example of the integration of indigenous knowledge into science lessons. Now apart from **environmental chemistry**, apart from atom is there any topic that maybe when you are teaching it you think of bring in this indigenous knowledge

Meme S: uhh, they are quite many because when we are talking of Physical science this has to do with almost things around us, so when we are talking also looking at materials building houses, making traditional pots so you can even ask learners to bring traditional materials made from local different type of materials like ceramics, wood and others thing then you can also say this is also part of our indigenous materials that we can also use at school by bring you ask learners they can also say aaa this is the thing that we use at home that is also part of science

Me: the other question is about the **advantages** of indigenous knowledge, when you include indigenous knowledge can you see or does indigenous knowledge have advantages in our lessons

Meme S: jaa, it has an advantage because learners can feel that in things we are using at home is also part of their learning, so they can also know how to take care of their things, their plants or whatever because it's kind of an encouragement that at least let me say I don't have money to go and buy either tin made from fabric or what so ever I can even use what I have at my disposal at home I can even make my own tin

Me: ok, so one of the **advantage** it means people they can use local available materials instead of going to the shop to go and buy something, so you are saying is easily available and cheap. Ok now, you talked about ceramic, I know ceramic is also something which is local, it's easy to get and cheap, you also talked about, what else did you talk about?

Meme S: eenyandi

Me: eenyandi also available, so when you talk about this ceramic, is there a topic in Physical Science where you can include it specifically in grade 9

Meme S: scratching her head

Me: or is it grade 10

Meme S: grade 10

Me: if it's grade 10 how do you use to incorporate it do the learner use to bring the made already or they use to come do it at school

Meme S: sometimes when we say ceramic you give an example and you ask learners go home find anything and bring it that is made out off, then you can see that learners they knows exactly this is made from ceramic this is from whatever and so on

Me: ok, now I asked about the advantage, now if something it has the advantage it might also have the disadvantage. Any **disadvantage** on the inclusion of indigenous knowledge in our lesson

Meme S: uhhh, jaaa the disadvantage is maybe that some if you ask every learner to bring a lemon not all houses has lemons, so it might be difficult for them to bring the lemon and only those that have and, the second disadvantage is not found all the time, not available so they got seasonal time, it depend now what time do you teach that topic, if it's during whatever they are not bear any fruits then there is nowhere learner can bring any fruits. I think that one is the disadvantage

Me: now, specifically on your side when you use to include this indigenous knowledge do you use to have any **challenges**. What use to be the reaction of the learners let say for example now you are teaching then you talk about something they know at home, how do the learners use to react?

Meme S: jaa sometimes the challenge can be I don't know is carrying out an experiment sometimes it very vey hard, sometimes you might think if I do A, B then am expecting this one to happen sometimes you put it then the reaction will not give you the result, jaa and sometimes when you said for example when you said tomorrow everybody bring a lemon or what so ever and you find yourself they did not bring that one, so somehow we are not 100%

Me: Now, if I may ask you since you are a grade 9 Physical Science teacher, according to yourself, I know you use to include indigenous knowledge already, now if I may ask you in the shoes of other teachers, why do you think other teachers **don't or may include indigenous knowledge**

Meme S: uhhh, that one depends on how one prepare eee sometimes the way you prepare, if you prepare you lesson with time not just say bring tomorrow we are going to do A B C then you find learner did not bring that means you are not going to, so one has to be prepare know what do you need for you to carry out that experiment

Me: the other question is about the teaching practice that we are using does it allow you to incorporate indigenous knowledge

Meme S: jaa, when we look at the time allocated 40 minutes eee at least for one to carry out that practical, sometimes it's no enough unless the person (teacher) has to decide maybe either to do it on the afternoon or you have just to do it by demonstrating then you find yourself with the limited resources and you have a group of learners more that means it might not every learners has a chance to do that one on her on or sometimes you find the litmus paper or whatever they are not enough, so that will be a challenge, because if you said we are going to use every learners at least to have one of it is her own, then it will be a challenge because they only have to see, some not

Me: now, if I may ask you, what need to be **done for teachers for them** to be able to include indigenous knowledge since you said that indigenous knowledge is even there in the curriculum, now what need to be done as teachers, as many as teachers who are teaching Physical Science grade 8, 9, 10, 11 and 12 need to include indigenous knowledge

Meme S: jaa, is high time now that school need at least to have some kind of plants or plan maybe that will be happening after 10 years, planting a tree that bears that especially lemon or whatever schools know that I will need it for ….. for use late if they can bear or maybe the school should see to it of buy materials that teacher need to use in their practical experiments

Me: now you are talking the issue of buying at first you said that this materials are local they are from within the environments, are lemon is well known if you don't have it at school the school has to buy, now if I may ask you another question, now we have been talking about environment chemistry, we talked about atoms and …. when I was a teacher also for Physical Science I find it hard for me to incorporate indigenous knowledge in to science language because of the advantage that you said it's A B C D. Now if I may ask eee you have described the local knowledge that you use to use in the Physical Science, let me bring something like, I will just give example of a topic eee fractional distillation have you ever thought about that topic that it's also applicable to our community

Meme S: jaa, fractional distillation that has to do with oxygen and nitrogen nee, I think when we look at this topic it also it now on grade 10 but it can applicable also to grade what? to grade nine when we are dealing with eeee uhhh looking at …………… (pause)

Me: separation of mixture

Meme S: in grade 9 that only few of it because learners their it only being taught what is the different between mixture what what, it was more in grade 9 , so grade 8 but that thing is no longer there

Me: no longer in grade 8

Meme S: uhhh even no in 9 no in 10 this thing of …

Me: the knowledge has been moved there to the other level

Meme S: jaaa

Me: ok, the last question that I would like to ask you, just to say maybe you could describe apart from the local knowledge that we have been talking is there any local knowledge that maybe when we were talking there it came into your mind then you want to say it, so is the any local knowledge that you would like to describe how you have incorporated it into Physical Science lessons

Meme S: jaa, it's like talking of making pure water, when we look at this acid and bases then we come to the pH value there is neutral one distilled water so sometimes when you are teaching this topic we also look at rain water, tape water that is not pure water, so it's also something that you can talk people are doing this traditional alcohol ombike, jaa so what do people do then we talk of fermentation the they put everything in a very big container you put eenyandi you put whatever then start fermenting and later it become alcohol, so the meme (lady) at home they use to make that traditional ombike, so the moment they know that this is full fermented what happen now they start boiling it so the first thing that goes off its pure alcohol then if you keep on boiling it, heating it then you get a pure water out of that one and the moment you test that one with a litmus paper it gives you a neutral colours then gives you 7 pH there.

Me: taa now you brought something in my mind, you talked about ombike and I know that, that is a very good example of incorporating indigenous knowledge into our lessons, because during that time when the ombike is boiling this meekulus (old ladies) at home they know that this is water, ok let me ask you this way when they to make ombike how do they use to know that now ombike is complete what might come out there is not pure ombike

Meme S: they know because they cannot measure I think they were just smart enough, they know that if I got a container of this pot then I got this one liter of cool drink the moments if full somewhere they know that this a pure alcohol then they take it out and put another one and they got a mixture of alcohol and water then again they measure that one from there again they put another container they know that this coming out they can test it they know, no alcohol in it, it’s pure pure water

Me: now in this modern science how can you incorporate that knowledge of making ombike into the lesson, science lessons

Meme S: no you only do this one telling, when we are talking of pure water and rain water especially when our old memes they are making ombike then they know this is something and how to get pure substances out of that and from there you also talk about boiling point, jaa then alcohol is always having the lowest boiling point, while water boil when it’s 100

Me: now, it means when our meekulus use to make this alcohol for them they estimated that if I put this container then it must fill this, now let come to the issue of fire how do they use to regulate the fire?

Meme S: no the fire is also moderated, so you can heat it hard because what come, the moments it boils and start moving up and down what comes out of that pipe is complete liquid and it will spoil everything, what comes out is the steam that is goes out when it condense they start dripping this is alcohol now being collected

Me: so that one now is …. they put a pipe like, a pipe from that pot to the container, in the middle the use to put something?

Meme S: they put water, you got something like okatemba (canoe) then you put a copper wire, a copper type in there, you close everything with sand so that the smoke should not go aware the the steam that is coming out from the container just go through that pipe and the water that is in the okatemba (canoe) just to cool down the steam that is in the pipe then start dripping out the you put something at the end the you collect that one

Me: this is very interesting, to see that local knowledge can be integrated into our lessons, you talked of ombike, acid and base, you talked of atoms the example can go on and on. Meme S let me that you for this short interview, I know if I may need clarity on some of the questions I may come back to you and find out. So this research after am done it might help teachers on how they have to integrate the local knowledge from the community into their lesson. thank you very much and I hope after transcribing this I will give it back to read through or if you like I can give this interview video and the audio for you at least to have a copy also. Thank you very much

Meme S: Thank you sir

APPENDIX J: COLLATED QUESTIONNAIRE RESPONSES

TEACHER'S QUESTIONNAIRE

I **Fredrick Simataa Simasiku**, student number **13s7222,** doing **Master in Science Education** with Rhodes University, would like to request all Physical Science teachers in Endola circuit teaching Grade 9 to take part in my research project by completing the following questionnaire. The focus of my study is to explore *Grade 9 Physical Science teachers' views and experiences on the inclusion of local/traditional knowledge (indigenous knowledge) in their lessons in Endola Circuit of Ohangwena Region.*

The information obtained in this questionnaire will be anonymous and your name will not be used. *However, if you are willing for me to interview and observed your lesson on how you include local knowldge, may you kindly contact me using the following number* **0811284219** *or sms interview, I will call you back.* If the space provided is not enough; feel at liberty to use a separate sheets or papers

Please answer all the questions as freely and honestly as you wish.

PART A: **Profile ofteachers and schools**

7. School location (tick one)

Urban	**Rural**	**Semi-urban**	**Semi-Rural**
	7		3

8. Gender

Male	**Female**
4	6

9. Ethnicity (tick the correct one)

Kwanyama	**Ndonga**	**Herero**	**Zambezian**	**Ngadjera**	**Others**
8			1		1

10. Qualifications (tick the qualifications you have)

ECP	**BETD**	**ACE/FDE/ MASTEP**	**HONS**	**MEd**	**PHD**	**Other**
	5	3	2			

11. Teaching Experience in Physical Science Grade 9 and total teaching experience?

Teaching experience in Physical Science Grade 9	**Total teaching experience**

12. Age group (Tick one box)

20 - 25 yrs	26 – 30	31 - 35	36 - 40	41 – 45	46 - 50	Above 50
1	0	5	1	1	1	1

PART B: Teachers' views and experiences

15. What do you understand by the term local/traditional knowledge (indigenous knowledge)?

T1Q1F – In my views, indigenous knowledge means the practices and contents of a certain subjects that are known and applied by the people in a certain environment where the teaching of the subject took place

T2Q2F – Local/traditional knowledge (indigenous) are knowledge you learnt from the area, tribe where you belongs, I could say is the knowledge of our local people ways of living, cultural background, norms, festival and beliefs

T3Q3F – the term local or traditional knowledge I understand it as a daily life situation

T4Q4F – Knowledge that we learn from our grand parents

T5Q5F- Indigenous knowledge refers to a local community, traditional technology, social, economic and philosophical learning grounded in spirituality, skills, practices and ways of being in nature

T6Q6F- This is all about knowing the norms and morals of one's culture and other background aspects

T7Q7M- A way or an expression that make reference to the knowledge held by people from a particular locality

T8Q8M- This is the knowledge that is unique to a culture or society around the world, it developed from experience gained over the centuries and adopted to the local culture

T9Q9M- Indigenous knowledge is the ideas a person use to make something or proof without using the scientific experiments

T10Q10M- Is the knowledge that local people posses about their past and present on cultural life

16. What are your **views** on the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in grade 9?

T1Q1F- I think it is important to include local knowledge in teaching Physical Science lessons in grade 9 because this help learners to relate what they know to what they do not know. This will help them to understand better. By including local knowledge will also give opportunity to parents to help their children in the subject

T2Q2F- Most of our learners are traditional skilled because they don't have yet those modern skill due to poverty which we leave in, therefore I support local knowledge to be included

T3Q3F- During the lessons the inclusion of local knowledge helps learners to understand better because sometimes learners fear Physical Science in such a way that their background about Physical Science was negative

T4Q4F- They can be included in the lesson as well to stimulate the understand of the learners as well and to have the interest in the lesson

T5Q5F- It helps us to transfer our traditional knowledge into science curriculum and create rich learning experiences for our learners. Learners learn about sustain life and protect our planet, energy and resources. It also helps improve our planet and environment for the next seven generation

T6Q6F- They are applicable because Physical Science is all about knowing things which are around us including things which other people use to do in the past which are applied in teaching Physical Science

T7Q7M- That is a way that make a person to understand things in his/her mother language

T8Q8M- The inclusion of local knowledge with Physical Science lessons prevent a cultural divert when the student or learners are learning the meaningful Physical Science

T9Q9M- It is good to build to what already learners know from home

T10Q10M- it is very beneficial when you use local examples, learners will relate better

17. What factors do you think influence your views on the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in grade 9?

T1Q1F- Materials available, sometimes the materials are not available, Limited Time, and Lack of experience on a certain subject content

T2Q2F- Understand: Explaining scientific term in indigenous language so that learners understand better. Local traditional methods: Science is everywhere in the communities. Motivation: learners are motivated by learning by doing. Pride: Education start at home and learners are well informed and, Cultural diversity: Knowledge is in society as well

T3Q3F- (Note answered)

T4Q4F- The scientific knowledge that I have learned in school, and some of the indigenous knowledge cannot be proved, they are myth

T5Q5F- Lack of indigenous knowledge among learners as well as teachers, and parents are not available to deliver traditional technology

T6Q6F- community understanding most people do not want to disclose what they do their things

T7Q7M- It makes a person (learners) to understand very well how or what something is to be done

T8Q8M- Race, ethnicity and home environment- this is because science exists in a cultural context, this is why non-western learners struggle with Physical science, and Societal expectations – background and customs may influence the inclusion of local knowledge as some of those of indigenous may not go in one line with that of Physical Science

T9Q9M- Sometimes there is no scientific proof

T10Q10M- It is always good to start from the known to the unknown, so the known part is about the local or indigenous knowledge

18. What are your **experiences** of local/traditional knowledge (indigenous knowledge) that might relate to western or scientific ideas or processes?

(d) At your home?

T1Q1F- The process of producing a vambo liquor can be related to fractional distillation method in Physical Science as a method for separating mixture, and use homemade substances and classify them as acids and bases e.g Sour milk, Oshikundu etc. but not only the laboratory substances

T2Q2F- We brew traditional Oshikundu, tell story at fire, social evening, eat together, plough and haverst

T3Q3F- (Not answered)

T4Q4F- That do not open your mouth when it is raining and there is lightning because the teeth are made of calcium (it has Ca^{+}) that can be attracted to the lightning. Do not stay closer to animals if there is lightning because their fur are always charged and can be attracted by a lightning

T5Q5F- Building of traditional house relate to deforestation and soil erosion, burning firewood relate to combustion reaction, and drying wet clothes relate to temporally change

T6Q6F- At our home I know things like brewing ovambo-liquor namely ombike. This is done through distillation and preparing home-made beer called Oshikundu

T7Q7M- Translating the views in local language can help

T8Q8M- Cooking- local knowledge ideas of cooking are all the same as those of western ideas, and spacing of food- the ideas of making food taste by using local knowledge and western ideas us the same

T9Q9M- Experiences from home are not notes

T10Q10M- there are some local plants that can save as dyes and can be used in laboratories to identify substances

(e) In your community?

T1Q1F- looking at real life local examples of : Static electricity eg sparks produced by touching some materials, Combustion eg burning of firewood, Physical change eg melting of fat, and fermentation eg making Oshikundu (traditional beer)

T2Q2F- Learners eat traditional made bread for breakfast, men drink fermented wambo liquor (wine), and they use of traditional products and equipments, pots, transport eg donkey cart and sledge

T3Q3F- (not answered)

T4Q4F- the process by which ombike is prepared is the same as distillation

T5Q5F- put on short heel shoes in sandy environment ralate to pressure, driving or riding horses in the community relate to air pollution , and keep too many animals in the environment relate to soil erosion and deforestation

T6Q6F- In my community people also ferment traditional beer called otombo whereby they sorghum is added in a bucket with water and sugar and it left to ferment the whole night to produce alcohol and carbon dioxide

T7Q7M- people are always understood if they listen to someone who speak the local language and has a local knowledge for that ….. locality

T8Q8M- (Not answered)

T9Q9M- traditional healers use local knowledge to treat people on different diseases which is the same as the ideas of western culture, and indigenous people use their local knowledge to cultivate their crops which is the same of the western

T10Q10M- elderly people back home used to brew traditional beer that involve several scientific process tha can be used in the classroom situation, for examples, during the brewing process they let the content to ferment or they add what we call mulungo (catalyst) to speed up the process

(f) At your school
T1Q1F- Making indicators by using plant materials such as red cabbage, beetroot and red flower that can be used as a universal indicator to indicate whether a substances is acid or alkali

T2Q2F- Cultural festival at schools show case of a lot of traditional & indigenous knowledge, and school cultural groups dancing during events

T3Q3F- (Not answered)

T4Q4F- I cannot remember of any

T5Q5F- planting trees relate to rain formation, and filtration relate to clean water from wells and boreholes

T6Q6F- at our school learners and teachers do produce carbon dioxide whereby they prepare a traditional bread called omungome, they prepare a dough and left it to raise for some minutes

T7Q7M- learners gets more ideas via local knowledge

T8Q8M- at school indigenous knowledge used to be included in the lesson to make learners to understand what is at home can be used in the classroom

T9Q9M- mostly at school we use western or scientific ideas because are noted in books

T10Q10M- at school indigenous knowledge is only used to make learners to understand the lesson, this knowledge cannot be written in tests or examination so there is little time given to them during the lesson

19. Describe any local/traditional knowledge (indigenous knowledge) you have been exposed to at your home/community that has a process or facts about:

(h) Farming production?
T1Q1F- No experience on that

T2Q2F- Breeding traditional chicken, cropping: Mahangu, sorghum and beans, and cattle farming and goat farming

T3Q3F- (Not answered)

T4Q4F- (not answered)

T5Q5F- Apply kraal manure on the soil before start prepare the soil for cultivation, this will increase the crop production because it add nutrients in the soil

T6Q6F- A farming production we do in our houses and community involves milking the cows and put that milk in a storage and one has to store it there for few days before shaking it to remove fat from it

T7Q7M- People are told to keep farming mahangu due to starvation

T8Q8M- the use of ridging techniques where by farmers form a continuous lump of elevated soil mount during cultivation, so the western used this techniques and further developed them to assist in checking soil erosion and conservation of water

T9Q9M- Farming production, animals are kept to solve problem in the family

T10Q10M- you can use animal dung as manure to improve soil structure and fertility

(i) Medicine?

T1Q1F- Using herbs such as tomato leaves or mahangu powder known as onghundu to heal chronic cough. Those materials are applied in the large intestine at the back

T2Q2F- Hydration and exercise is the best medicine but we have a lot of traditional herbs/plant that can heal numerous illness

T3Q3F- (Not answered)

T4Q4F- (not answered)

T5Q5F- Salt water is used as medicine to cure coughing amongst people

T6Q6F- In my community the medicine are prepared depending on what king of treatment that people need. Example: if the person is bitten by the snake people will put some herbs and an specialist someone will cut and suck the blood out of a affected area

T7Q7M- Treating crops can be done by collecting insects or digging holes

T8Q8M- The African potato for example has traditional used for its many medicinal properties, traditional healers used it to treat cancer, so the western developed a medicine that enhances the body natural defense system

T9Q9M- In traditional we use different herbs to treat different diseases, eg: cough, bitten by a snake

T10Q10M- you can use guava leaves to moderate a cough or coughing and you can use peri-peri to treat chicken coughs

(j) Brewing of homemade drinks or beers?

T1Q1F- the process of making Oshikundu. Mahangu meal is mixed with hot water and then sorghum meal (flour) is also added. The mixture is the diluted with cold water. The mixture is covered and left for one or two days. After that it will start to produce bubbles which is an indication of carbon dioxide produced from carbohydrates from meals

T2Q2F- brewing: traditional beer (omalodu from sorghum), wine: from palm tree (omulunga), hot staff: from grapes, palm fruit, fig etc

T3Q3F- (Not answered)

T4Q4F- placing the clay pot of oshikundu in the sun during winter for it to get ready

T5Q5F- Sorghum flour could be mixed with water and boiled for some minutes and prepare correctly to come up with traditional beer

T6Q6F- preparing Oshikundu and omalondu whereby one has to leave them fermenting for the whole night and only to drink the next day

T7Q7M- drinks can be made from various fruits such as ‘eembe’, jackal fruit, palm fruit etc

T8Q8M- Africans use the mahangu/maize meal to make their home drinks since the natural sugar in it make it to rise. The westerns use this ideas of natural sugar and developed it into the study of fermentation process and the study of yeast that enhance fermentation (enzyems)

T9Q9M- the traditional brew mostly are made from the fruits

T10Q10M- some local fruits like marura is used to brew beer

(k) Building?
T1Q1F- Making bricks and thatching, we normally use clay soil to make bricks for building sleeping rooms and cut glasses and use them as thatching roofs

T2Q2F- Grass roofing and traditional chopping poles

T3Q3F- (Not answered)

T4Q4F- Using cow dugs as plastering on wall of the traditional hut to make the room warm enough

T5Q5F- Clay soil is used to make bricks in order to construct traditional hut and roof can be made from grass and hay as well as sticks

T6Q6F- in my area people are not allowed to build closer or near trees as their roots may cause cracking

T7Q7M- Homes and huts can be made from clay soils without using cements and stones

T8Q8M- (not answered)

T9Q9M- the building are made stronger by making a wall mixing mad (clay soil) and animal dugs

T10Q10M- wooden poles can be used to build roofing and wall structure

(l) Predicting Weather or Rain?
T1Q1F- I have never exposed to this

T2Q2F- Animal behavior like the steppe eagle movement, pelicans and flamingos and numerous birds can predict the rain

T3Q3F- (Not answered)

T4Q4F- when certain birds (that almost look like bats) are flying around

T5Q5F- when the moon is on then people believed that rain is no more raining

T6Q6F- in our community if one want to predict the rain one has to look at trees and certain birds when they appear or seen somewhere

T7Q7M- people use a symbols of plants as they are getting flowers or an insects are digging their holes in the soil to predict rain

T8Q8M- Farmers used or have been using combination of various biological, meteorological and astronomical indicators to predict the rainfall such as wind flow, temperature changes etc and this goes in line with the scientific

T9Q9M- we predict rain if there is too much hotness meaning that it will rain soon

T10Q10M- people sometimes look at some birds if certain birds seem to fly over in the sky they can relate it to either possible abundance of rain or possible drought

(m) Lightning?
T1Q1F- Running during of hiding under the tree can cause any one to be strike by lightning. Wearing red clothing can cause one to be strike by lightning. Those are the story told by elders but not conformed if it is true

T2Q2F- Wood called (Omulavi) a branch erected on top of the hut to prevent it from strike by lightning

T3Q3F- (Not answered)

T4Q4F- Staying away from the animals during lightning because their fur are charged and can attract the lighting

T5Q5F- when lightning cause a lot of damage on earth it believed that there will be many girls to be born that year

T6Q6F- people prevent the lightning by putting certain piece of tree (Omulavi) on top of the huts and if the lightning strikes one has place make sure you do not come in conduct with that place until it is cleaned

T7Q7M- people use 'Omundali' a plant/tree used to prevent the lightning and its branch used to be placed on top of the hut

T8Q8M- the old people or even current local people use the local knowledge that the visit of Scopus umbretta bird at homestead is associated with strike by lightning in that homestead

T9Q9M- some people are specialize in treating a person strike by the lightning or remove the remain left by the lightning

T10Q10M- people relate the hotness to lightning, during the rain when it's hot during the day and they can predict that the rain that will rain will be very dangerous and warn children not play in it if it will rain. They also relate lightning with tall object and moving object, for examples, during lightning they don't touch water or paddling because they believe that the movement of water can attract lightning

(n) Others?
T1Q1F- (Not answered)

T2Q2F- Ash – for cleaning purposes and grass to filtrate water

T3Q3F- (Not answered)

T4Q4F- (Not answered)

T5Q5F- if Mopane trees produce many cones still it believed that there will be heavy rain in that specific year

T6Q6F- (Not answered)

T7Q7M- (Not answered)

T8Q8F- (Not answered)

T9Q9M- (Not answered)

T10Q10M- long time ago before the soap, people were using the ash from the fire to wash their pot and they hard specific tree that could produce white ash that can be used to wash the pot. Even today this knowledge is still used by elderly people to clean the pots.

20. What were your past **experiences** on the inclusion of local/traditional knowledge (indigenous knowledge) duringPhysical Science lessons?
    (c) When you were taught as a learner at school?

T1Q1F- Evaporation process related to when over cooking meat all of the water disappear

T2Q2F- we used traditional methods more often , indigenous –language for better understand and we used donkey carts for transport

T3Q3F- the time I started my primary which I can't remember until 1995 when I completed my grade 12

T4Q4F- It was never part of what I was taught in school

T5Q5F- When I was a learner at school during Physical Science, I believed that IK go hand with Physical Science as a subject because what our forefather or mother taught us long as, we are doing in science

T6Q6F- people/teacher were afraid to mix traditional knowledge with scientific one as they assume the local traditional one is far behind

T7Q7M- it improved my livehood and experiences

T8Q8M- the use of traditional herbs when having a stomach ache was one of my past experience which will act as a base to nuetralise acid produced in the stomach which led to the development of Eno

T9Q9M- (Not answered)

T10Q10M- the experience is that there was little inclusion of local indigenous knowledge but some local plant or petals were used to make dyes or indicators for testing the acidity or alkalinity

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

T1Q1F- Observed how electricity is produced by using moving water at Ruacana power station

T2Q2F- I was more advanced, traditional method improved with the latest technology

T3Q3F- 1996-1998

T4Q4F- it was never part of what I was taught at university

T5Q5F- at college is where I strongly agreed that what we do in our real life situation is what we put into practice in science. I also believed that our traditional knowledge is important because it lead us to a better understanding

T6Q6F- at tertiary level local/traditional knowledge was included as we were allowed to use our own knowledge the things we know already informs our practical and investigation

T7Q7M- It applied to maintain my insight and skills of doing things nice

T8Q8M- One of my past experience at university was fire making, indigenous people use sticks to make fire which was scientifically developed to a match making in a sense that friction can produce fire

T9Q9M- (Not answered)

T10Q10M- at college level we were encourage to use local indigenous knowledge but the problem was that some names of local plants are not known scientifical

21. As a Physical Science teacher, have you ever used local/traditional knowledge (indigenous knowledge) in your teaching?

YES	**NO**
10	

(d) If **YES**, what was the topic or what were the topics that you used local/traditional knowledge (indigenous knowledge) in?

T1Q1F- Combustion, Physical and Chemical Change and Acid and Bases (Alkali)

T2Q2F- Fermentation and chromatography

T3Q3F- Chemical reactions, Acid and bases and pressure between solids

T4Q4F- static electricity

T5Q5F- Kinetic particle theory of matter

T6Q6F- In the topics like combustion and static electricity

T7Q7M- Density

T8Q8M- Friction and acid and bases

T9Q9M- Application of acid and alkalis, treatment of acidic soil because traditional we add manure in the soil and we believe that plant cannot grow well if soil contain salt

T10Q10M- Acid and bases or environmental chemistry you can use wood ash to neutralize bases

(e) Explain how you used the local/traditional knowledge (indigenous knowledge) in teaching the topic or topics?

T1Q1F- In Combustion I demonstrate combustion with lighting a match stick, In Physical and chemical change I demonstrate examples such as burning wood, melting fat, cooking and drying clothes. I gave examples of acid and base in the local environment

T2Q2F-Fermentation –grapes, palm fruits, figs are use to produce alcohol, Chromatography-this is done when a mixture of palm leaves and water with barks from grape trees turn palm leaves red and making tea from sorghum flour

T3Q3F- in pressure between solids I take my learner outside in the sand, I tell them to compare different shoes types when walking on the sand and ask question how they feel

T4Q4F-traditional, we do not wear red clothes when it’s raining we do not sleep on our backs, and we do not open our mouths if there is lightning

T5Q5F- I normally use it during an introduction phase , teachers presentation and use it in assessment purpose (homework)

T6Q6F- In the topic like combustion I allow learners to demonstrate on how they prepare firewood and how to burn those firewood

T7Q7M- what causes a ships to float? It is diplacing a lot of water that can push it upwards when water returns to its original location, its mass is smaller than the amount of water

T8Q8M- I use friction which has been used in fire making by using two stick which then lead to a development of match box and stick. The use of traditional herbs to treat stomach ache which lead to the development of eno, all of this I use them as examples referred to traditional knowledge

T9Q9M- crops do not grow well in soil that has too much salt therefore we add manure to neutralize the salt in water

T10Q10M- wood ash can be used to neutralize bases e.g you can use ash to wash off fats from dishes and pots or to brush teeth

(f) If **NO**, what could be the reasons why you never used local/traditional knowledge (indigenous knowledge) during your science lessons?

T1Q1F- (Not answered)

T2Q2F- Fermentation and chromatography

T3Q3F-Is impossible not to include local knowledge in any topic because learners will not get anything

T4Q4F- (Not answered)

T5Q5F- (Not answered)

T6Q6F- (Not answered)

T7Q7M- (Not answered)

T8Q8M- (Not answered)

T9Q9M- (Not answered)

T10Q10M- (not answered)

d) In which **topics** do you think local/traditional knowledge (indigenous knowledge) can be easily used?

T1Q1F- Building blocks of matter, Acid and Bases, and Physical and chemical change

T2Q2F- Acids and bases and matter

T3Q3F- In my opinion local knowledge is applicable in all topics

T4Q4F- In static electricity

T5Q5F- the kinetic particle theory of matter and chemical change

T6Q6F- all the topics

T7Q7M- Acids and Bases

T8Q8M- Acid and bases

T9Q9M- In two types on changes: Physical and Chemical change

T10Q10M- acid and Bases

e) How could local/traditional knowledge (indigenous knowledge) be used in some of these topics? Could you please give details of how you could use it in a particular topic in teaching Physical Science lessons?

T1Q1F- In building block of matter bricks can be compared to compound that are made up of sand and cements that can be compared to atoms, In acid and bases give examples of substances found at home or local as acid or bases so that learners can understand what is acid and what is a base. Use local example to demonstrate physical and chemical change

T2Q2F- In acid and base put palm leave to turn fresh milk to sour, wood from omanghudi (tree) turn fresh milk sour and chromatograph using barks from omuve to turn dry palm leaves red

T3Q3F- For examples when I am teaching building blocks of matter, I have to give example of how the class in which we are was made from very small particles eg sand or cement

T4Q4F- That if it is raining and there is a lightning do not lie on your back because the acid (HCl) in your stomach will produce H^+ ions which will be attracted to the negative charges on the clouds that cause lightning

T5Q5F- the kinetic particles theory of matter can give or explain on diffusion by give examples of herbs that our mothers had been applying on their bodies for good smell, chemical change like he/she can explain on long ago policy of burning a pregnant girls that is never returned back when she died

T6Q6F- One just have to allow learners to use their knowledge on topics this can be done trough investigation

T7Q7M- by asking learners how to do Oshikundu, brewing beer

T8Q8M- local knowledge can be used in this topic by giving relevant examples based on daily life which has to do with treatment and neutralizing of poisonous things

T9Q9M- In physical change a teacher give example that learners use every day at home like mixing sand and cement, in chemical change a teacher give examples like burning firewood

T10Q10M- using petals of the plant that can be used as indicators to test the substances which is acid of alkali. We can also use the liquor like Kachipembe (ombike), 7 days liquor and other local substances that can be used in the classroom or incorporate into the lesson to test whether they are acid or bases

22. Is there any statement that promotes the use of local/traditional knowledge (indigenous knowledge) in the Grade 9 Physical Science curriculum/syllabus?

T1Q1F- Yes, this is when the syllabus needs everyday examples to be given in a specific topic

T2Q2F- indicator turning fresh milk to sour

T3Q3F- yes, as we are requested to give examples from our daily life situation

T4Q4F- No

T5Q5F- Yes, there is a statement written practical activities, approaches or demonstrations

T6Q6F- Yes, practical, investigation allows one to use traditional knowledge and local knowledge

T7Q7M- Yes, acid identify and name examples of acid in everyday life, discuss that acids are common in foods, particulary fruits and that they have a sour taste

T8Q8M- (Not answered)

T9Q9M- No

T10Q10M- yes it indicates the use of life experiences of learners and the use of local available materials

23. What do you think what could be the reasons why **other** Grade 9 Physical Science teachers
(d) **Include** local/traditional knowledge (indigenous knowledge) during their Physical Science lessons?
T1Q1F- They are indigenous and they know the local tradition of the people in that specific environment

T2Q2F- It is needed to educate learners that local materials or substances are used also in science

T3Q3F- The reason is just to make learners understand better and easy like I said it earlier

T4Q4F- It important for better understanding of the objectives by the learners

T5Q5F- This could be because during lessons, teachers let learners to interact by give their pre-knowledge and is normally traditional knowledge

T6Q6F- This allows learners to familiarize themselves with what they already know

T7Q7M- To make learners understanding and preventing them from dangerous things

T8Q8M- this is because this make things easier for the learners as the examples of local knowledge relates the scientific ideas to some of the prior knowledge of learners which make it easy for learners to understand

T9Q9M- They want to give the real examples that learners see every day and makes them easily to understand

T10Q10M- this helps to bring reality home, it helps learners to understand better

(e) Do **not include** local/traditional knowledge (indigenous knowledge) in their Physical Science lessons?
T1Q1F- they do not know very well the tradition of the learners they a teaching or they are not exposed to local knowledge

T2Q2F- If not you limit indigenous knowledge to be transfer from generation to generation

T3Q3F- No ideas if there would be a Physical science teacher who don't include local/traditional knowledge at all

T4Q4F- Because some of the traditional knowledge are myths, they cannot be proven

T5Q5F- I think one of the main reason is they use teacher centred approach. They do not give chances to learners to think about what they know already concern a topic. Teacher may lack indigenous knowledge concerning the topics

T6Q6F- This does not allow learners to be exposed to real life situation

T7Q7M- Encourage them to find the answers from other people (peers)

T8Q8M- Traditional knowledge do not always fit in every topics in Physical Science, traditional knowledge are not known well by the teachers since when they were trained, they were not trained about them

T9Q9M- Because some of the knowledge are difficult to translate them into indigenous knowledge

T10Q10M- the could be language barrier because some people or teachers do not teach in their areas of birth, so what they know in their language may not be the same with the area where they work

24. (a) What do you think could be the **advantages** of including local/traditional knowledge (indigenous knowledge) in Physical Science lessons?

T1Q1F- It helps learners to relate what they know to what they do noy know and make the understanding better

T2Q2F- To save money, to identify the link between modern science and traditional science

T3Q3F- learners will understand well and fast, learners will develop a positive image of the subject, and learners will be motivated to become future science teachers

T4Q4F- learners will understand more because they are relating what they are taught to what they see happening at home or in the community

T5Q5F- to help learners to think critically on the topic and to reflect back on the traditional knowledge, it helps learners to pass well in tests, homework as well as examination because they reflect back quickly on what they did during science lesson

T6Q6F- this broaden the knowledge of the learners in such a way that learners are exposed to different situations

T7Q7M- Only to make learners understanding things in his/her own language

T8Q8M- It relate the concepts to what learners already knew and it make the lesson more interesting and all learners will pays more attentions

T9Q9M- The traditional knowledge learners they learn them a lot from their parents

T10Q10M- it makes it easy for learners to understand and it is easy to bring real life examples in the classroom that learners knows from home

(b) What do you think could be the **disadvantages** of includinglocal/traditional knowledge (indigenous knowledge)in Physical Sciences lessons?

T1Q1F- If some of the learners are not from the local environment it might be difficult for them to understand

T2Q2F- some indigenous knowledge are not approved due to lack of information

T3Q3F- learners will not get you well, they will not like the subject, they will also feel like you are talking about heavenly things

T4Q4F- Learners are from different traditions and thus they will not understand some of the knowledge from a different tradition from theirs

T5Q5F- sometimes is time consuming, learners use up more time to respond to the questions, lack of indigenous knowledge among learners because parent do not stay with their children to deliver spirituality skills

T6Q6F- they might be some contradiction between indigenous knowledge and new knowledge (western knowledge)

T7Q7M- the learners could not answers questions in their mother language when they are in an examination sessions

T8Q8M- (Not answered)

T9Q9M- because some of the facts you cannot proof them or there is no evidence

T10Q10M- the knowledge may not be universal, since these examples are not in other languages, culture or countries

25. Do you think local/traditional knowledge (indigenous knowledge) should be included in Grade 9 or not? (tick in each statements for your choice)

Statements	**Strongly Agree**	**Agree**	**Not sure**	**Disagree**	**Strongly Disagree**
Curriculum	5	2	0	2	0
Syllabus	3	5	0	2	0
Textbooks	4	5	0	1	0
Lessons plans	4	3	3	0	0
Lesson delivery	4	6	0	0	0
Practical work/Activities	5	2	1	2	0
Tests/Examinations	4	3	1	2	0
General discussion	5	4	1	0	0

Part C: Usage of indigenous knowledge in Physical Science lessons

26. Which of the following instructional methods do you consider to be critical for including local/traditional knowledge (indigenous knowledge) in Physical Science lessons?

Tick the ***six most critical(Top six)***instructional methods for the inclusion of IK into Physical Science lessons in the 3rd column. Thereafter, r***ank*** them in the 4th column from the most critical = 1 to the least critical = 6.

Item	**Instructional methods for integrating science and indigenous knowledge**	**Top six**	**Rank**
11.1	Using a holistic or an integrated instructional approach.	6	6,5,2,4,6,3
11.2	Using as much as possible concrete materials to illustrate concepts or principles.	10	3,5,4,5,3,6,5,2,1,2
11.3	Emphasizing ‘showing’ or modeling rather than lecturing.	9	4,3,6,6,4,3,2,3,4
11.4	Involving learners actively in problem-solving activities.	8	2,3,1,5,6,5,3,5

11.5	Starting lessons with learners' ideas before presenting the scientific view.	9	1,1,2,2,2,3,1,2,1
11.6	Extending science classroom discussions to include the IK modes of inquiry, e.g. inviting IK experts into class on some topics.	5	1,1,1,4,6
11.7	Clarify that indigenous knowledge can co-exist with science that it should not be replaced by it, and has not been replaced by it.	3	5,1,6
11.8	Assess each knowledge claim with its own assumptions and standards rather than using science to judge indigenous knowledge as true or false.	3	6,4,6
11.9	Teach science using ways that are also used to teach indigenous knowledge e.g. informal conversation and learning through observation and imitation.	1	4
11.10	Making lesson people oriented rather than information oriented.	1	3
11.11	Emphasize cooperative learning rather than competitive leaning.	1	5
11.12	Provide learners ample opportunities to investigate and present their findings.	4	2,5,4,4

27. Explain the choice you have made as to why these instructional methods are more critical than the others?

T1Q1F- they are more critical because they need a lot of preparation for example finding models and concrete materials it needs time. The time allocated to the lessons is also limited so it is not eas to extend lessons to include indigenous knowledge in lessons

T2Q2F- by using concrete materials simple because is available and cheap as well as easy to use and control. It helps learners to participate and decision making because everyone knows how to use indigenous materials learnt it from home

T3Q3F- (Not answered)

T4Q4F- Some of the IK needs to be understood by the learners mainly through practice and seeing the results. The learners need to carry out experiments to prove some of the IK (for those that can be tried) and learners should be able to present their ideas of what they know about the IK

T5Q5F- they are showing that there is no inclusion of indigenous knowledge during lesson presentation they are reflecting wrong ideas of implementing traditional knowledge during the lesson

T6Q6F- The choices I have made allow learners to be exposed to different situation and this give learners so much ideas about the topic covered during the lesson

T7Q7M- Learners can use their knowledge and skills about scientific views in the lesson

T8Q8M- they are more critical in such a way that learners will learn and understand better if they are more interested in problem solving. Using modeling rather than lecturing will help learners to integrate the theory with the practice

T9Q9M- I arrange them from the most important

T10Q10M- these methods are critical because they are more interactive in the classrooms compared to others in terms of using them in the classroom

28. **General comments**: What else would you like to share with me regarding the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in Grade 9?

T1Q1F- I think for the teachers to include indigenous knowledge in their lessons better they need to work hand in hand with elders in the community so that they can explain and demonstrate to the learners

T2Q2F- Traditional knowledge helps learners to develop and assimilate scientific knowledge with indigenous knowledge. More new knowledge if come together and share that knowledge they learnt in classes they will use them in future

T3Q3F- (Not answered)

T4Q4F- learners will understand more and the lessons will be interesting if they are learning what they have seen happening in their community

T5Q5F- Nothing else

T6Q6F- I would love to share that the idea of including local/traditional knowledge during Physical science lesson allow learners to get sense of what is being taught without undermining once knowledge as all of them are of equal importance. Thus local/traditional knowledge must be included in the curriculum

T7Q7M- IK is local, experiential, holistic and orally, it is typical and belongs to people from specific places with common cultural and social ties

T8Q8M- (Not answered)

T9Q9M- (Not answered)

T10Q10M- the books should be written with the inclusion of local indigenous knowledge to have the uniformity on which local knowledge to be included and examined in the examination

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

APPENDIX K: COLLATED QUESTIONNAIRES AND INTERVIEWS RESPONSES

Questions	answer
29. What do you understand by the term local/traditional knowledge (indigenous knowledge)?	T1Q1F – In my views, indigenous knowledge means the practices and contents of a certain subjects that are known and applied by the people in a certain environment where the teaching of the subject took place T2Q2F – Local/traditional knowledge (indigenous) are knowledge you learnt from the area, tribe where you belongs, I could say is the knowledge of our local people ways of living, cultural background, norms, festival and beliefs T3Q3F – the term local or traditional knowledge I understand it as a daily life situation T4Q4F – Knowledge that we learn from our grand parents T5Q5F- Indigenous knowledge refers to a local community, traditional technology, social, economic and philosophical learning grounded in spirituality, skills, practices and ways of being in nature T6Q1F- This is all about knowing the norms and morals of one's culture and other background aspects T7Q7M- A way or an expression that make reference to the knowledge held by people from a particular locality T8Q8M- This is the knowledge that is unique to a culture or society around the world, it developed from experience gained over the centuries and adopted to the local culture T9Q9M- Indigenous knowledge is the ideas a person use to make something or proof without using the scientific experiments T10Q10M- Is the knowledge that local people posses about their past and present on cultural life T1SSIM - eee, local or indigenous knowledge I believe this is knowledge that let say people has before, the knowledge that they acquired maybe just from the environment where they are living because you find some people did not go to school, they they are not taught, they are not been taught Physical science or any other subjects, but you find that they have a knowledge, let say like the meekulus (Old Meme) and tatekulus (Old tate) they make a liquor that they use to drink. T2SSIF- jaa, local means thing that you found within the surrounding, within the communities that you can bring in as a real teaching aid and knowledge we also have our fore fathers and other people who is at home using some traditional plants or whatever that they can use either by making tea, whatever you want like medicine that we use in our local that why sometimes when you are teaching we include and we say this is now local instead of this artificial (western) things

30. What are your **views** on the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in grade 9?	T1Q1F- I think it is important to include local knowledge in teaching Physical Science lessons in grade 9 because this help learners to relate what they know to what they do not know. This will help them to understand better. By including local knowledge will also give opportunity to parents to help their children in the subject T2Q2F- Most of our learners are traditional skilled because they don't have yet those modern skill due to poverty which we leave in, therefore I support local knowledge to be included T3Q3F- During the lessons the inclusion of local knowledge helps learners to understand better because sometimes learners fear Physical Science in such a way that their background about Physical Science was negative T4Q4F- They can be included in the lesson as well to stimulate the understand of the learners as well and to have the interest in the lesson T5Q5F- It helps us to transfer our traditional knowledge into science curriculum and create rich learning experiences for our learners. Learners learn about sustain life and protect our planet, energy and resources. It also helps improve our planet and environment for the next seven generation T6Q6F- They are applicable because Physical Science is all about knowing things which are around us including things which other people use to do in the past which are applied in teaching Physical Science T7Q7M- That is a way that make a person to understand things in his/her mother language T8Q8M- The inclusion of local knowledge with Physical Science lessons prevent a cultural divert when the student or learners are learning the meaningful Physical Science T9Q9M- It is good to build to what already learners know from home T10Q10M- it is very beneficial when you use local examples, learners will relate better T1SSIM- indigenous knowledge eee for example if I may to mention few examples, I think the very topics that one can include the indigenous knowledge it's, that is the topics that include some processes T2SSIF- so I have to include it because they have to start from something that they know that they find in the community then you add to something (western knowledge) that come in, I like to include it I don't want to exclude it because it part of the syllabus T2SSIF- jaa, in our syllabus their they are stating that learners can also use teaching aid from their locality, therefore it's important that we have to (showing action with hands)

31. What factors do you think influence your views on the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in grade 9?	T1Q1F- Materials available, sometimes the materials are not available, Limited Time, and Lack of experience on a certain subject content T2Q2F- Understand: Explaining scientific term in indigenous language so that learners understand better. Local traditional methods: Science is everywhere in the communities. Motivation: learners are motivated by learning by doing. Pride: Education start at home and learners are well informed and, Cultural diversity: Knowledge is in society as well T3Q3F- (Note answered) T4Q4F- The scientific knowledge that I have learned in school, and some of the indigenous knowledge cannot be proved, they are myth T5Q5F- Lack of indigenous knowledge among learners as well as teachers, and parents are not available to deliver traditional technology T6Q6F- community understanding most people do not want to disclose what they do their things T7Q7M- It makes a person (learners) to understand very well how or what something is to be done T8Q8M- Race, ethnicity and home environment- this is because science exists in a cultural context, this is why non-western learners struggle with Physical science, and Societal expectations – background and customs may influence the inclusion of local knowledge as some of those of indigenous may not go in one line with that of Physical Science T9Q9M- Sometimes there is no scientific proof T10Q10M- It is always good to start from the known to the unknown, so the known part is about the local or indigenous knowledge T1SSIM- there is a very big, most of this things have good advantage, have benefited the learners, this is because science is something let say first belongs to the western people and so on, but the moment this knowledge, local knowledge is being included this will make work easier for our learners because they are some of the things that you maybe mentioning in the lesson at a school in the village and no one will have the ideas of that
32. What are your **experiences** of local/traditional knowledge (indigenous knowledge) that might relate to western or scientific ideas or processes?	**(g) At your home?** T1Q1F- The process of producing a vambo liquor can be related to fractional distillation method in Physical Science as a method for separating mixture, and use homemade substances and classify them as acids and bases e.g Sour milk, Oshikundu etc. but not only the laboratory substances T2Q2F- We brew traditional Oshikundu, tell story at fire, social evening, eat together, plough and haverst T3Q3F- (Not answered) T4Q4F- That do not open your mouth when it is raining and there is lightning because the teeth are made of calcium (it has Ca^{+}) that

	can be attracted to the lightning. Do not stay closer to animals if there is lightning because their fur are always charged and can be attracted by a lightning T5Q5F- Building of traditional house relate to deforestation and soil erosion, burning firewood relate to combustion reaction, and drying wet clothes relate to temporally change T6Q6F- At our home I know things like brewing ovambo-liquor namely ombike. This is done through distillation and preparing home-made beer called Oshikundu T7Q7M- Translating the views in local language can help T8Q8M- Cooking- local knowledge ideas of cooking are all the same as those of western ideas, and spacing of food- the ideas of making food taste by using local knowledge and western ideas us the same T9Q9M- Experiences from home are not notes T10Q10M- there are some local plants that can save as dyes and can be used in laboratories to identify substances **(h) In your community?** T1Q1F- looking at real life local examples of : Static electricity eg sparks produced by touching some materials, Combustion eg burning of firewood, Physical change eg melting of fat, and fermentation eg making Oshikundu (traditional beer) T2Q2F- Learners eat traditional made bread for breakfast, men drink fermented wambo liquor (wine), and they use of traditional products and equipments, pots, transport eg donkey cart and sledge T3Q3F- (not answered) T4Q4F- the process by which ombike is prepared is the same as distillation T5Q5F- put on short heel shoes in sandy environment ralate to pressure, driving or riding horses in the community relate to air pollution , and keep too many animals in the environment relate to soil erosion and deforestation T6Q6F- In my community people also ferment traditional beer called otombo whereby they sorghum is added in a bucket with water and sugar and it left to ferment the whole night to produce alcohol and carbon dioxide T7Q7M- people are always understood if they listen to someone who speak the local language and has a local knowledge for that ….. locality T8Q8M- (Not answered) T9Q9M- traditional healers use local knowledge to treat people on different diseases which is the same as the ideas of western culture, and indigenous people use their local knowledge to cultivate their crops which is the same of the western T10Q10M- elderly people back home used to brew traditional beer that involve several scientific process tha can be used in the classroom situation, for examples, during the brewing process they let the content to ferment or they add what we call mulungo (catalyst) to speed up the process **(i) At your school**

	T1Q1F- Making indicators by using plant materials such as red cabbage, beetroot and red flower that can be used as a universal indicator to indicate whether a substances is acid or alkali T2Q2F- Cultural festival at schools show case of a lot of traditional & indigenous knowledge, and school cultural groups dancing during events T3Q3F- (Not answered) T4Q4F- I cannot remember of any T5Q5F- planting trees relate to rain formation, and filtration relate to clean water from wells and boreholes T6Q6F- at our school learners and teachers do produce carbon dioxide whereby they prepare a traditional bread called omungome, they prepare a dough and left it to raise for some minutes T7Q7M- learners gets more ideas via local knowledge T8Q8M- at school indigenous knowledge used to be included in the lesson to make learners to understand what is at home can be used in the classroom T9Q9M- mostly at school we use western or scientific ideas because are noted in books T10Q10M- at school indigenous knowledge is only used to make learners to understand the lesson, this knowledge cannot be written in tests or examination so there is little time given to them during the lesson
33. Describe any local/traditional knowledge (indigenous knowledge) you have been exposed to at your home/community that has a process or facts about:	**(o) Farming production?** T1Q1F- No experience on that T2Q2F- Breeding traditional chicken, cropping: Mahangu, sorghum and beans, and cattle farming and goat farming T3Q3F- (Not answered) T4Q4F- (not answered) T5Q5F- Apply kraal manure on the soil before start prepare the soil for cultivation, this will increase the crop production because it add nutrients in the soil T6Q6F- A farming production we do in our houses and community involves milking the cows and put that milk in a storage and one has to store it there for few days before shaking it to remove fat from it T7Q7M- People are told to keep farming mahangu due to starvation T8Q8M- the use of ridging techniques where by farmers form a continuous lump of elevated soil mount during cultivation, so the western used this techniques and further developed them to assist in checking soil erosion and conservation of water T9Q9M- Farming production, animals are kept to solve problem in the family T10Q10M- you can use animal dung as manure to improve soil structure and fertility **(p) Medicine?** T1Q1F- Using herbs such as tomato leaves or mahangu powder known as onghundu to heal chronic cough. Those materials are applied in the large intestine at the back

	T2Q2F- Hydration and exercise is the best medicine but we have a lot of traditional herbs/plant that can heal numerous illness T3Q3F- (Not answered) T4Q4F- (not answered) T5Q5F- Salt water is used as medicine to cure coughing amongst people T6Q6F- In my community the medicine are prepared depending on what king of treatment that people need. Example: if the person is bitten by the snake people will put some herbs and an specialist someone will cut and suck the blood out of a affected area T7Q7M- Treating crops can be done by collecting insects or digging holes T8Q8M- The African potato for example has traditional used for its many medicinal properties, traditional healers used it to treat cancer, so the western developed a medicine that enhances the body natural defense system T9Q9M- In traditional we use different herbs to treat different diseases, eg: cough, bitten by a snake T10Q10M- you can use guava leaves to moderate a cough or coughing and you can use peri-peri to treat chicken coughs **(q) Brewing of homemade drinks or beers?** T1Q1F- the process of making Oshikundu. Mahangu meal is mixed with hot water and then sorghum meal (flour) is also added. The mixture is the diluted with cold water. The mixture is covered and left for one or two days. After that it will start to produce bubbles which is an indication of carbon dioxide produced from carbohydrates from meals T2Q2F- brewing: traditional beer (omalodu from sorghum), wine: from palm tree (omulunga), hot staff: from grapes, palm fruit, fig etc T3Q3F- (Not answered) T4Q4F- placing the clay pot of oshikundu in the sun during winter for it to get ready T5Q5F- Sorghum flour could be mixed with water and boiled for some minutes and prepare correctly to come up with traditional beer T6Q6F- preparing Oshikundu and omalondu whereby one has to leave them fermenting for the whole night and only to drink the next day T7Q7M- drinks can be made from various fruits such as 'eembe', jackal fruit, palm fruit etc T8Q8M- Africans use the mahangu/maize meal to make their home drinks since the natural sugar in it make it to rise. The westerns use this ideas of natural sugar and developed it into the study of fermentation process and the study of yeast that enhance fermentation (enzyems) T9Q9M- the traditional brew mostly are made from the fruits T10Q10M- some local fruits like marura is used to brew beer **(r) Building?**

	T1Q1F- Making bricks and thatching, we normally use clay soil to make bricks for building sleeping rooms and cut glasses and use them as thatching roofs T2Q2F- Grass roofing and traditional chopping poles T3Q3F- (Not answered) T4Q4F- Using cow dugs as plastering on wall of the traditional hut to make the room warm enough T5Q5F- Clay soil is used to make bricks in order to construct traditional hut and roof can be made from grass and hay as well as sticks T6Q6F- in my area people are not allowed to build closer or near trees as their roots may cause cracking T7Q7M- Homes and huts can be made from clay soils without using cements and stones T8Q8M- (not answered) T9Q9M- the building are made stronger by making a wall mixing mad (clay soil) and animal dugs T10Q10M- wooden poles can be used to build roofing and wall structure **(s) Predicting Weather or Rain?** T1Q1F- I have never exposed to this T2Q2F- Animal behavior like the steppe eagle movement, pelicans and flamingos and numerous birds can predict the rain T3Q3F- (Not answered) T4Q4F- when certain birds (that almost look like bats) are flying around T5Q5F- when the moon is on then people believed that rain is no more raining T6Q6F- in our community if one want to predict the rain one has to look at trees and certain birds when they appear or seen somewhere T7Q7M- people use a symbols of plants as they are getting flowers or an insects are digging their holes in the soil to predict rain T8Q8M- Farmers used or have been using combination of various biological, meteorological and astronomical indicators to predict the rainfall such as wind flow, temperature changes etc and this goes in line with the scientific T9Q9(e)M- we predict rain if there is too much hotness meaning that it will rain soon T10Q10M- people sometimes look at some birds if certain birds seem to fly over in the sky they can relate it to either possible abundance of rain or possible drought **(t) Lightning?** T1Q1F- Running during of hiding under the tree can cause any one to be strike by lightning. Wearing red clothing can cause one to be strike by lightning. Those are the story told by elders but not conformed if it is true T2Q2F- Wood called (Omulavi) a branch erected on top of the hut to prevent it from strike by lightning T3Q3F- (Not answered)

	T4Q4F- Staying away from the animals during lightning because their fur are charged and can attract the lighting T5Q5F- when lightning cause a lot of damage on earth it believed that there will be many girls to be born that year T6Q6F- people prevent the lightning by putting certain piece of tree (Omulavi) on top of the huts and if the lightning strikes one has place make sure you do not come in conduct with that place until it is cleaned T7Q7M- people use 'Omundali'(omulavi) a plant/tree used to prevent the lightning and its branch used to be placed on top of the hut T8Q8M- the old people or even current local people use the local knowledge that the visit of Scopus umbretta bird at homestead is associated with strike by lightning in that homestead T9Q9M- some people are specialize in treating a person strike by the lightning or remove the remain left by the lightning T10Q10M- people relate the hotness to lightning, during the rain when it's hot during the day and they can predict that the rain that will rain will be very dangerous and warn children not play in it if it will rain. They also relate lightning with tall object and moving object, for examples, during lightning they don't touch water or paddling because they believe that the movement of water can attract lightning **(u) Others?** T1Q1F- (Not answered) T2Q2F- Ash – for cleaning purposes and grass to filtrate water T3Q3F- (Not answered) T4Q4F- (Not answered) T5Q5F- if Mopane trees produce many cones still it believed that there will be heavy rain in that specific year T6Q6F- (Not answered) T7Q7M- (Not answered) T8Q8F- (Not answered) T9Q9M- (Not answered) T10Q10M- long time ago before the soap, people were using the ash from the fire to wash their pot and they hard specific tree that could produce white ash that can be used to wash the pot. Even today this knowledge is still used by elderly people to clean the pots.
34. What were your past **experiences** on the inclusion of local/traditional knowledge (indigenous knowledge) duringPhysical Science lessons?	**(e) When you were taught as a learner at school?** T1Q1F- Evaporation process related to when over cooking meat all of the water disappear T2Q2F- we used traditional methods more often , indigenous – language for better understand and we used donkey carts for transport T3Q3F- the time I started my primary which I can't remember until 1995 when I completed my grade 12 T4Q4F- It was never part of what I was taught in school T5Q5F- When I was a learner at school during Physical Science, I believed that IK go hand with Physical Science as a subject

	because what our forefather or mother taught us long as, we are doing in science T6Q6F- people/teacher were afraid to mix traditional knowledge with scientific one as they assume the local traditional one is far behind T7Q7M- it improved my livehood and experiences T8Q8M- the use of traditional herbs when having a stomach ache was one of my past experience which will act as a base to nuetralise acid produced in the stomach which led to the development of Eno T9Q9M- (Not answered) T10Q10M- the experience is that there was little inclusion of local indigenous knowledge but some local plant or petals were used to make dyes or indicators for testing the acidity or alkalinity T1SSIM- but they are nothing more differ, there is no that big difference on how we were taught, its only that now there are so many experiments that can we do T2SSIF- uhh, jaa it was interesting because I was thinking that I was very fortunate learner because my teacher was so motivated, know the subject knowledge well and he was so even doing practical things with us it was very interesting that why I even get motivated to learn more in physical science **(f) When you were taught as a student at tertiary level (College, Technikon or University)?** T1Q1F- Observed how electricity is produced by using moving water at Ruacana power station T2Q2F- I was more advanced, traditional method improved with the latest technology T3Q3F- 1996-1998 T4Q4F- it was never part of what I was taught at university T5Q5F- at college is where I strongly agreed that what we do in our real life situation is what we put into practice in science. I also believed that our traditional knowledge is important because it lead us to a better understanding T6Q6F- at tertiary level local/traditional knowledge was included as we were allowed to use our own knowledge the things we know already informs our practical and investigation T7Q7M- It applied to maintain my insight and skills of doing things nice T8Q8M- One of my past experience at university was fire making, indigenous people use sticks to make fire which was scientifically developed to a match making in a sense that friction can produce fire T9Q9M- (Not answered) T10Q10M- at college level we were encourage to use local indigenous knowledge but the problem was that some names of local plants are not known scientifically

(g) If **YES**, what was the topic or what were the topics that you used local/traditional knowledge (indigenous knowledge) in? In which **topics** do you think local/traditional knowledge (indigenous knowledge) can be easily used	T1Q1F- Combustion, Physical and Chemical Change and Acid and Bases (Alkali) T2Q2F- Fermentation and chromatography T3Q3F- Chemical reactions, Acid and bases and pressure between solids T4Q4F- static electricity T5Q5F- Kinetic particle theory of matter T6Q6F- In the topics like combustion and static electricity T7Q7M- Density T8Q8M- Friction and acid and bases T9Q9M- Application of acid and alkalis, treatment of acidic soil because traditional we add manure in the soil and we believe that plant cannot grow well if soil contain salt T10Q10M- Acid and bases or environmental chemistry you can use wood ash to neutralize bases T1Q1F- Building blocks of matter, Acid and Bases, and Physical and chemical change T2Q2F- Acids and bases and matter T3Q3F- In my opinion local knowledge is applicable in all topics T4Q4F- In static electricity T5Q5F- the kinetic particle theory of matter and chemical change T6Q6F- all the topics T7Q7M- Acids and Bases T8Q8M- Acid and bases T9Q9M- In two types on changes: Physical and Chemical change T10Q10M- acid and Bases T1SSIM- eee in a Physical Science they are other topics like acid and bases T1SSIM- eee, apart from experiments you may just include it maybe by, by giving examples, eee let say you are teaching maybe a topic on eee, let say a on a force, let say friction. Our tatekulus' and mekulus; have that ideas that if two objects are maybe touching each other it may cause, may cause heat between them and they used the what? the fat from what they get from the milk of the animals to rubricate them
(h) Explain how you used the local/traditional knowledge (indigenous knowledge) in teaching the topic or topics? How could local/traditional knowledge (indigenous knowledge) be used in some of these topics? Could you	T1Q1F- In Combustion I demonstrate combustion with lighting a match stick, In Physical and chemical change I demonstrate examples such as burning wood, melting fat, cooking and drying clothes. I gave examples of acid and base in the local environment T2Q2F-Fermentation –grapes, palm fruits, figs are use to produce alcohol, Chromatography-this is done when a mixture of palm leaves and water with barks from grape trees turn palm leaves red and making tea from sorghum flour T3Q3F- in pressure between solids I take my learner outside in the sand, I tell them to compare different shoes types when walking on the sand and ask question how they feel

please give details of how you could use it in a particular topic in teaching Physical Science lessons?	T4Q4F-traditional, we do not wear red clothes when it's raining we do not sleep on our backs, and we do not open our mouths if there is lightning T5Q5F- I normally use it during an introduction phase , teachers presentation and use it in assessment purpose (homework) T6Q6F- In the topic like combustion I allow learners to demonstrate on how they prepare firewood and how to burn those firewood T7Q7M- what causes a ships to float? It is diplacing a lot of water that can push it upwards when water returns to its original location, its mass is smaller than the amount of water T8Q8M- I use friction which has been used in fire making by using two stick which then lead to a development of match box and stick. The use of traditional herbs to treat stomach ache which lead to the development of eno, all of this I use them as examples referred to traditional knowledge T9Q9M- crops do not grow well in soil that has too much salt therefore we add manure to neutralize the salt in water T10Q10M- wood ash can be used to neutralize bases e.g you can use ash to wash off fats from dishes and pots or to brush teeth T1Q1F- In building block of matter bricks can be compared to compound that are made up of sand and cements that can be compared to atoms, In acid and bases give examples of substances found at home or local as acid or bases so that learners can understand what is acid and what is a base. Use local example to demonstrate physical and chemical change T2Q2F- In acid and base put palm leave to turn fresh milk to sour, wood from omanghudi (tree) turn fresh milk sour and chromatograph using barks from omuve to turn dry palm leaves red T3Q3F- For examples when I am teaching building blocks of matter, I have to give example of how the class in which we are was made from very small particles eg sand or cement T4Q4F- That if it is raining and there is a lightning do not lie on your back because the acid (HCl) in your stomach will produce H^+ ions which will be attracted to the negative charges on the clouds that cause lightning T5Q5F- the kinetic particles theory of matter can give or explain on diffusion by give examples of herbs that our mothers had been applying on their bodies for good smell, chemical change like he/she can explain on long ago policy of burning a pregnant girls that is never returned back when she died T6Q6F- One just have to allow learners to use their knowledge on topics this can be done through investigation T7Q7M- by asking learners how to do Oshikundu, brewing beer T8Q8M- local knowledge can be used in this topic by giving relevant examples based on daily life which has to do with treatment and neutralizing of poisonous things T9Q9M- In physical change a teacher give example that learners use every day at home like mixing sand and cement, in chemical change a teacher give examples like burning firewood T10Q10M- using petals of the plant that can be used as indicators to test the substances which is acid of alkali. We can also use the

	liquor like Kachipembe (ombike), 7 days liquor and other local substances that can be used in the classroom or incorporate into the lesson to test whether they are acid or bases T1SSIM- at home, let say your sting by, by a bee people taking some leaves, let say they chew it and have to apply it where the bee stings you, meaning that when that leaves now have been applied there, the pain or so reduced, this is explaining that maybe the leaves has reacted with what the bee have injected in the person thing which could be an acid and maybe the leaves to act as the base to neutralize the acid on the skin and this will go in line with what teachers explain when they trying to neutralize something on the laboratory, even when they are explaining the use of Eno, when the person has the stomach pain, stomach pain then that there is too much hydrochloric acid in the stomach and what is to take the Eno so that it neutralize the acid T1SSIM- eee, learners may have this, may have also come across about why, let say there is eee, this traditional beer that we make in our houses and so on, when it stay too long maybe for two days, it become too much sour and for one to drink it maybe one has to apply sugar or maybe one has to apply water, which is a little bit an idea that there is a kind of something like diluting which is now to reduce that test that it has before T1SSIM- if it's now become sour, it's will be like an acid, that why it has to be what? has to be neutralize so that it will test a little different T1SSIM- eee on friction, let say if I may to explain on friction, on the content in the book what so ever and syllabus or so, learners are being taught that friction is the force that acts on the opposite direction to the moving objects but eee let say when they are, they are, let say when they are, they have, they have to unlock a certain nuts which is (pause) Me: tightened T1SSIM- tightened eee for this learner if, if the learner have to unlock that, there is a need to, let say oil like grease to be applied on that Me: to be applied on the T1SSIM- so that it make easier for the unlocking of the nut, but the learner can only use that using eee that knowledge

	from, let say from home when they are, let say when they are, even having the, the what? they when the parents are making those skinned to be (giving action with the hand) Me: to softened T1SSIM- to be softened, to be softened they also apply that, when they are doing that the skin have to be what? (showing action by using hands) to be soft, for a learner, if the learner have that idea one can have the clear picture that, yes the applying of what? of the oil or what so ever (pause) Me: to make it to be soft T1SSIM- Something or it makes work to be easy, so that is an example one can give when teaching this topic so that learner can find out, at home or the people is also learning that idea that how friction works. The other things is when they are making fire, this idea of friction they sticks to do this (demonstrating with hands) if the keeps on doing that, when they are doing that the friction their it become hot, this is the some idea that we are using when we are lighting a matches T1SSIM- like you who have seen that, then that means friction can cause fire or it can cause thing to be worn, the learner by having that idea that when it come to the classroom situation will have that idea that if am to, let say if am to move a box from one place to another, I don't need to pull it on the floor since the, the what? the surface are not that smooth because it may cause damage on the, damage on the box which is not needed
(i) If **NO**, what could be the reasons why you never used local/traditional knowledge (indigenous knowledge) during your science lessons?	T3Q3F-Is impossible not to include local knowledge in any topic because learners will not get anything
35. Is there any statement that promotes the use of local/traditional knowledge (indigenous knowledge) in	T1Q1F- Yes, this is when the syllabus needs everyday examples to be given in a specific topic T2Q2F- indicator turning fresh milk to sour T3Q3F- yes, as we are requested to give examples from our daily life situation

the Grade 9 Physical Science curriculum/syllabus?	T4Q4F- No T5Q5F- Yes, there is a statement written practical activities, approaches or demonstrations T6Q6F- Yes, practical, investigation allows one to use traditional knowledge and local knowledge T7Q7M- Yes, acid identify and name examples of acid in everyday life, discuss that acids are common in foods, particulary fruits and that they have a sour taste T8Q8M- (Not answered) T9Q9M- No T10Q10M- yes it indicates the use of life experiences of learners and the use of local available materials
36. What do you think what could be the reasons why **other** Grade 9 Physical Science teachers (f) **Include** local/traditional knowledge (indigenous knowledge) during their Physical Science lessons?	T1Q1F- They are indigenous and they know the local tradition of the people in that specific environment T2Q2F- It is needed to educate learners that local materials or substances are used also in science T3Q3F- The reason is just to make learners understand better and easy like I said it earlier T4Q4F- It important for better understanding of the objectives by the learners T5Q5F- This could be because during lessons, teachers let learners to interact by give their pre-knowledge and is normally traditional knowledge T6Q6F- This allows learners to familiarize themselves with what they already know T7Q7M- To make learners understanding and preventing them from dangerous things T8Q8M- this is because this make things easier for the learners as the examples of local knowledge relates the scientific ideas to some of the prior knowledge of learners which make it easy for learners to understand T9Q9M- They want to give the real examples that learners see every day and makes them easily to understand T10Q10M- this helps to bring reality home, it helps learners to understand better
(g) Do **not include** local/traditional knowledge (indigenous knowledge) in their Physical Science lessons?	T1Q1F- they do not know very well the tradition of the learners they a teaching or they are not exposed to local knowledge T2Q2F- If not you limit indigenous knowledge to be transfer from generation to generation T3Q3F- No ideas if there would be a Physical science teacher who don't include local/traditional knowledge at all T4Q4F- Because some of the traditional knowledge are myths, they cannot be proven T5Q5F- I think one of the main reason is they use teacher centred approach. They do not give chances to learners to think about what they know already concern a topic. Teacher may lack indigenous knowledge concerning the topics

	T6Q6F- This does not allow learners to be exposed to real life situation T7Q7M- Encourage them to find the answers from other people (peers) T8Q8M- Traditional knowledge do not always fit in every topics in Physical Science, traditional knowledge are not known well by the teachers since when they were trained, they were not trained about them T9Q9M- Because some of the knowledge are difficult to translate them into indigenous knowledge T10Q10M- the could be language barrier because some people or teachers do not teach in their areas of birth, so what they know in their language may not be the same with the area where they work T2SSIF- uhhh, that one depends on how one prepare eee sometimes the way you prepare, if you prepare you lesson with time not just say bring tomorrow we are going to do A B C then you find learner did not bring that means you are not going to, so one has to be prepare know what do you need for you to carry out that experiment T1SSIM- one maybe eee let say a person or a teacher is not that use to what is happening in the environment T1SSIM- another thing the teacher may have, may include the indigenous knowledge without him or herself knowing what he is doing T1SSIM- yes, and maybe, the other why they don't include it maybe they find it boring to them but only if they don't know what is real happening in the what? in the environment
37. (a) What do you think could be the **advantages** of including local/traditional knowledge (indigenous knowledge) in Physical Science lessons?	T1Q1F- It helps learners to relate what they know to what they do noy know and make the understanding better T2Q2F- To save money, to identify the link between modern science and traditional science T3Q3F- learners will understand well and fast, learners will develop a positive image of the subject, and learners will be motivated to become future science teachers T4Q4F- learners will understand more because they are relating what they are taught to what they see happening at home or in the community T5Q5F- to help learners to think critically on the topic and to reflect back on the traditional knowledge, it helps learners to pass well in tests, homework as well as examination because they reflect back quickly on what they did during science lesson T6Q6F- this broaden the knowledge of the learners in such a way that learners are exposed to different situations T7Q7M- Only to make learners understanding things in his/her own language

	T8Q8M- It relate the concepts to what learners already knew and it make the lesson more interesting and all learners will pays more attentions T9Q9M- The traditional knowledge learners they learn them a lot from their parents T10Q10M- it makes it easy for learners to understand and it is easy to bring real life examples in the classroom that learners knows from home T2SSIF- jaa, it has an advantage because learners can feel that in things we are using at home is also part of their learning, so they can also know how to take care of their things, their plants or whatever because it's kind of an encouragement that at least let me say I don't have money to go and buy either tin made from fabric or what so ever I can even use what I have at my disposal at home I can even make my own tin T1SSIM- there is a very big, most of this things have good advantage, have benefited the learners, this is because science is something let say first belongs to the western people and so on, but the moment this knowledge, local knowledge is being included this will make work easier for our learners because they are some of the things that you maybe mentioning in the lesson at a school in the village and no one will have the ideas of that T1SSIM- yes, but the person can only get to understand and to know what does the thing mean or does the content mean it only when we can give example from the local knowledge being brought up that when one can open up and understand T1SSIM- to be active, to understand better the concepts, even to know how to apply something into the real life experience
(b) What do you think could be the **disadvantages** of includinglocal/traditional knowledge (indigenous knowledge)inPhysical Sciences lessons?	T1Q1F- If some of the learners are not from the local environment it might be difficult for them to understand T2Q2F- some indigenous knowledge are not approved due to lack of information T3Q3F- learners will not get you well, they will not like the subject, they will also feel like you are talking about heavenly things T4Q4F- Learners are from different traditions and thus they will not understand some of the knowledge from a different tradition from theirs T5Q5F- sometimes is time consuming, learners use up more time to respond to the questions, lack of indigenous knowledge among learners because parent do not stay with their children to deliver spirituality skills T6Q6F- they might be some contradiction between indigenous knowledge and new knowledge (western knowledge)

	T7Q7M- the learners could not answers questions in their mother language when they are in an examination sessions T8Q8M- (Not answered) T9Q9M- because some of the facts you cannot proof them or there is no evidence T10Q10M- the knowledge may not be universal, since these examples are not in other languages, culture or countries T2SSIM- uhhh, jaaa the disadvantage is maybe that some if you ask every learner to bring a lemon not all houses has lemons, so it might be difficult for them to bring the lemon and only those that have and, the second disadvantage is not found all the time, not available so they got seasonal time, it depend now what time do you teach that topic, if it's during whatever they are not bear any fruits then there is nowhere learner can bring any fruits. I think that one is the disadvantage T2SSIF- jaa sometimes the challenge can be I don't know is carrying out an experiment sometimes it very vey hard, sometimes you might think if I do A, B then am expecting this one to happen sometimes you put it then the reaction will not give you the result, jaa and sometimes when you said for example when you said tomorrow everybody bring a lemon or what so ever and you find yourself they did not bring that one, so somehow we are not 100% T1SSIM- eee, the disadvantages will only comes when you give an examples which may be dangerous, because some of the examples we give learners may want to try them out then it become bad to give a what? eee, dangerous examples to a learner because a learner will try that out may be it will cause some injuries or any other thing which is not needed T1SSIM- they maybe some few difference but the difference will only come maybe with the names but maybe the work that this thing do is just the same, jaa for example if you talk of the catalyst that is just to speed up the reaction and the one to have oshipifilu (oshipithiso) is to make sure that when you put Oshikundu there it will not take that many hours for it to be read but just have to take some few hours. Which means these things are just the some they are only differ by the name or maybe by the work they do. T1SSIM- This challenges sometimes come on the, on the let say on putting this some of this thing on the language that you teach in the subject, Physical Science is quite …. and sometime you may have want to include a certain concept in the what? in lesson but you will not have that …. you don't,

	you will not know which word must I use in order to explain this clearly to the learners T1SSIM- am the other challenges is now goes with the topics that some topics may not have that good examples, let say by, by their own and if you try to explain them so that you familiarize the learners to what is happening in real life situation you will find it difficult to give an example or to to to to explain it just by using knowledge from home (Local or indigenous knowledge) or from the surrounding. These are the most challenging things, and that will, that will make it difficult for the learners to understand. T1SSIM- that is the things now, eee textbooks most of the things there, we can say they knowledge is being included in the textbooks but when they are included in the textbook they are not included as eee as ours because this western people sometimes they copy things from our people (long pause)
38. **General comments**: What else would you like to share with me regarding the inclusion of local/traditional knowledge (indigenous knowledge) during Physical Science lessons in Grade 9?	T1Q1F- I think for the teachers to include indigenous knowledge in their lessons better they need to work hand in hand with elders in the community so that they can explain and demonstrate to the learners T2Q2F- Traditional knowledge helps learners to develop and assimilate scientific knowledge with indigenous knowledge. More new knowledge if come together and share that knowledge they learnt in classes they will use them in future T3Q3F- (Not answered) T4Q4F- learners will understand more and the lessons will be interesting if they are learning what they have seen happening in their community T5Q5F- Nothing else T6Q6F- I would love to share that the idea of including local/traditional knowledge during Physical science lesson allow learners to get sense of what is being taught without undermining once knowledge as all of them are of equal importance. Thus local/traditional knowledge must be included in the curriculum T7Q7M- IK is local, experiential, holistic and orally, it is typical and belongs to people from specific places with common cultural and social ties T8Q8M- (Not answered) T9Q9M- (Not answered) T10Q10M- the books should be written with the inclusion of local indigenous knowledge to have the uniformity on which local knowledge to be included and examined in the examination