Integrating local indigenous knowledge in the teaching of water conservation by senior primary school Natural Science teachers: A Namibian case study

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By

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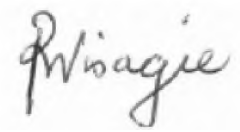
DECLARATION OF ORIGINALITY

I ***Ronald Arnold Visagie (15v7771)*** 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 Rhodes Education Departmental guidelines.

Signature: 

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ABSTRACT

The conservation of biodiversity to meet the needs and aspirations of present and future generations is a cornerstone for sustainable development. In response to this, one of the aims of Basic Education in Namibia is to develop an environmentally friendly society which has a concern for the conservation of water. Thus, the National Curriculum of Basic Education [NCBE], 2010, p. 8) expects Grade 6 Natural Science learners to be competent in using simple scientific models, methods and skills to make scientific sense of the natural environment; and most importantly for the learners to relate the implications of this scientific understanding to their personal and social health and the sustainable use of all natural resources for future generations. Additionally, teachers are encouraged to make innovative use of various knowledge systems including indigenous knowledge. However, there is no mention of how teachers should make use of local indigenous knowledge (IK) when teaching the topic on water conservation in particular.

It is against this backdrop that in this study I sought to understand how two Grade 6 Natural Science teachers use local indigenous knowledge in their classrooms to teach the topic of water conservation. This interpretive case study was carried out in collaboration with a rural community in the Erongo region. Data were collected in three stages. The first stage was the gathering of information through document analysis to strengthen my context. Documents such as the National Curriculum, Science Curriculum, Syllabi, Grade 6 Natural Science textbooks and SATs results were analysed to gain some insight and understanding of the issue before conducting interviews. In the second phase of this study I conducted semi-structured interviews with the Topnaar community members and two teachers. This was followed by classroom observations. Additionally, I used stimulated recall interviews (SRI) to provide clarity on how teachers use prior knowledge and mediate learning when teaching the topic water conservation using indigenous knowledge.

The study is informed by Vygotsky's (1978) socio-cultural theory in conjunction with Shulman's (1986) pedagogical content knowledge (PCK). Since a classroom is a social unit where interactions occur between teachers and learners, and learners and learners, these theories provided a useful lens for observing lessons and analysing teachers' content knowledge and how they mediate learning using local indigenous knowledge. A thematic approach to data analysis was adopted and

qualitative data were analysed inductively.

The findings of the study revealed that the indigenous knowledge amongst the Topnaars are governed by the ideals of Ubuntu. Findings also revealed that proper planning is needed to incorporate IK into science lessons as it may clear up misconceptions that may arise from indigenous knowledge. The study recommends that teachers and curriculum planners should explore different indigenous practices that are linked to the topics in the curriculum or syllabus to enhance learning and teaching in their science classrooms. It also recommends that curriculum developers, with the help of subject advisors, teachers and community members, should start planning on how indigenous knowledge can best be integrated into science textbooks as it has become a hindrance for the teachers to incorporate it.

DEDICATION

I learned from my mother, "*where there's a will, there's a way*". I learned from my father, "*always do the best job, your reputation is worth more than a quick profit*."

In memory of my mother, Naomi Visagie (1945-2015), and my father, Hendrik Johannes Visagie, as well as my wife Sandra and two children Wade and Kelsey, who taught and continue to inspire me to believe in myself, in God, and my dreams.

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On the same note, I would also like to extend my acknowledgement to the principals, research participants and Topnaar community members who allowed me into their schools, classrooms and living spaces. Thank you for your openness in sharing your expertise with me.

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Above all, I would like to thank God, the Almighty, for the strength and courage He gave me in order to do this study.

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ABBREVIATIONS AND/OR ACRONYMS

LCE – Learner Centred Education

TCE – Teacher Centred Education

IK – Indigenous Knowledge

LC – Local Knowledge

TK – Traditional Knowledge

ESD – Education for Sustainable development

WK – Western Knowledge

IP – Indigenous People

NIED – National Institute for Educational Development

NCBE – National Curriculum for Basic Education

MEC – Ministry of Education and Culture

MBEC – Ministry of Basic Education and Culture

MoE – Ministry of Education

MoEAC – Ministry of Education Arts and Culture

SPPS – Senior Primary Phase Syllabus

PCK – Pedagogical Content Knowledge

PEK – Prior Everyday Knowledge

CK – Content Knowledge

ZPD – Zone of Proximal Development

NMBEC – Namibia, Ministry of Basic Education and Culture

WASH – Water, Sanitation and Hygiene

UNICEF – United Nations Children's Emergency Fund

IUCN – International Union for Conservation of Nature

UNEP – United Nations Environmental Programme

WWF – Worldwide Fund for Nature

CBD – Convention for Biodiversity

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CHAPTER 1: SITUATING THE STUDY

> *Science has borrowed its knowledge from indigenous knowledges; and hence the inclusion of indigenous knowledges in the science lessons is a form of reconciliation and social justice that empowers the peoples by providing a voice to teachers, learners, and other community stakeholders interested in the education of their children (Shizha, 2006, p. 32).*

1.1 Introduction

This chapter introduces my research which was to explore the possibility of integrating local indigenous knowledge in the teaching of the topic of water conservation by two senior primary school Natural Science teachers in Walvis Bay, Erongo Region. About 100 km from Walvis Bay in the Namib Desert, the Topnaar community lives in traditional ways and still uses traditional methods to survive. I opine that this local knowledge could be of utmost importance when introduced into our lesson plans to give meaning to the importance of water conservation in particular in the context of this study.

The first section in this thesis thus outlines the context of my study followed by my problem statement, the significance of my study, the research goal, questions, and the definition of key concepts. Finally, I have delineated the structure of the study and presented a concise summary of each chapter.

1.2 Context of my study

Water and water conservation is of utmost importance to Namibia. According to du Toit and Sguazzin (1995),

> Namibia is a country of physical and cultural contrasts and encompasses *sparsely populated desert regions*... Large parts of Namibia are *very arid* and the availability of water is often the main limiting factor... Namibia's resources are replenished by *unreliable and irregular rainfall*. Due to the arid conditions the *soil has low fertility* and *indigenous vegetation is often slow-growing and sparse* (p. 17).

As a Life Science, Biology and Natural Science teacher with more than twenty years teaching experience, it is evident to me that the learners still lack awareness of and interest in the necessity for water conservation. The Water Sanitation and Hygiene (WASH) program that exists to

counteract this lack of awareness has as its objective "to contribute to the realization of children's rights to survival and development through promotion of the sector and support to national programs that increase equitable and sustainable access to, and use of safe water and basic sanitation services, and promote improved hygiene" (UNICEF, 2006, p. 1). It is a troubling fact, however, that the Namibian curriculum does not pay specific attention to water conservation in general. For instance, the closest that the National Curriculum for Basic Education (NCBE) has come to addressing water conservation is through environmental sustainability as reflected below:

> "The aims of the curriculum in relation to developing an environmentally sustainable society are to provide the scientific knowledge and skills, and attitudes and values needed to ensure that the environment is respected and sustained; and to develop the ability to make environmentally wise choices in terms of family development, as well as in economic activities" (MEC. NCBE, 2010, p. 8).

It is also disturbing to note that the inter-generational knowledge of local people is not widely acknowledged within formal education. Yet, local people who have lived in these harsh conditions for generations and are generating the knowledge and skills to use water wisely for their daily needs. For example, the Topnaar people in the Erongo region, who are a clan of the Nama people, have dealt with the issue of water scarcity for millennia in the desert areas of Namibia. I opine that the curriculum does not truly reflect the practical and urgent knowledge required on the ground about water, taking into consideration the pressure that is being placed on this scarce natural resource when it comes to domestic and industrial uses alike. To me this is a contradiction because on one hand the NCBE (2010) expects teachers to use various knowledge systems, including indigenous knowledge, but the situation on the ground differs as advisory teachers expect teachers to comply with themes and topics that measure up to international education requirements. This is evident in the Ministry of Education Arts and Culture (MoEAC), Natural Science and Health syllabus which state that "it is intended that the curriculum be learning-driven, not assessment- and examination-driven. Assessment and examination are to support learning" (MoEAC, 2015, p. 42). However, schools are measured according to their examination results, meaning that teachers and schools tend to focus on rote learning and strictly follow the curriculum to prevent being labelled as 'poor performers'.

Over the years there have been a number of international environmental conventions and protocols that have influenced, and have the potential to further influence, Namibian education. The United Nations Environment Program, for instance, indicates that global environmental practices have been identified as the only way to conserve our environment for future generations (UNEP, 1988). Organisations such as the United Nations Educational, Scientific and Cultural Organisation (UNESCO), the International Union for the Conservation of Nature (IUCN), the United Nations Environment Programme (UNEP), the Worldwide Fund for Nature (WWF) and other support agencies are playing a pivotal role through funding to influence the philosophy and policy orientation of environmental conservation. In 1997, the Thessaloniki Conference organised by UNESCO, promoted the idea of reorienting education towards sustainable development. Knapp (1998, pp. 12-13) regarded teacher training as one of the main opportunities to develop environmentally literate and responsible citizens.

As 2015 came to an end, and with it the 15-year cycle of the anti-poverty Millennium Development Goals (MDGs), the United Nations officially launched on 1 January 2016 – an even more ambitious set of goals to banish a whole host of social ills by 2030. According to the UN Secretary-General Ban Ki-moon, Sustainable Development Goals (SDGs) are a social contract between the world's leaders and the people to tackle climate change over the next 15 years (United Nations (2015). Given that Namibia is a signatory to these goals, the Ministry of Basic Education Arts and Culture will have to create quality education which acknowledges sustainable development. Of particular interest to this study is SDG number (6) "*Ensure access to water and sanitation for all*". This sustainable development goal speaks directly to my study.

I therefore opine that it is possible to develop a collaborative effort in tackling environmental issues, especially water conservation, in Namibia which is the focus of this study. In this context I am especially in agreement with Greenall and Robottom (1993), who argue that the aim of environmental learning activities is to enable learners, teachers and local community members to collaborate and participate fully in planning, implementing and evaluating environmental activities to transform the world. In my case study, two local grade 6 Natural Science teachers gathered local knowledge from the Topnaar community, and co-developed model lessons to teach the topic of water conservation with the inclusion of indigenous knowledge.

Svinicki (1994) indicates that the goal of learning is to incorporate new information into existing memories. Roschelle (1995) concurs by adding that "learning proceeds primarily from prior knowledge and also secondarily from presented materials" (p. 1). Stears, Malcolm and Kowlas (2003); Kuhlane (2011); Oloruntegbe and Ikpe (2011) lend support to the value of incorporating learners' prior knowledge in lessons by agreeing that conceptual achievement is higher when learners' prior knowledge is included in the classroom and assists them in developing an in-depth understanding of concepts. I support the views of these researchers that incorporating prior knowledge, especially indigenous knowledge (IK), in teaching can act as a useful tool to understanding the value of conserving our natural resources. Preparing and presenting model lessons will provide an opportunity for the teachers to assess what prior knowledge learners possess during their question session.

I have thus chosen my research topic for a number of reasons. "The Rio conventions, and particularly the Convention for Biodiversity (CBD) call for an integrated approach to conservation that incorporates local environmental knowledge and practices" (Cocks, Alexander & Dold, 2012, p. 241). The future preservation of both our cultural heritage and biodiversity relies on young people recognizing the importance and value of nature, and the need to use resources wisely. The following Sustainable Development Goals (SDGs) which was globally accepted forms part and at the same time speaks to my research topic is:

> Goal 4 - Ensure inclusive and equitable quality education and promote life-long learning opportunities for all;
> Goal 6 - Ensure availability and sustainable management of water and sanitation for all. (United Nations, 2015)

The Namibian curriculum includes the teaching of sustainable practices and development. It has also been shown that the inclusion of indigenous knowledge systems (IKS) into mainstream curriculums can promote conservation as well as cultural revitalization for indigenous people (Cocks, et al., 2012; Saenmi & Tillman, 2006).

Given the obvious rich opportunity for tapping into the extensive local and indigenous knowledge about water conservation in this part of Namibia, I have decided to locate my investigation in the

teaching and learning about water and water conservation through the inclusion of indigenous knowledge or local knowledge on this topic.

Essentially, the study sought to understand how local/traditional knowledge (indigenous knowledge) is being integrated by teachers teaching the topic water conservation. For this reason I give a framework below to show how the topic water is covered in the National curriculum, syllabuses, textbooks and National standardised tests to strengthen the context of my study.

1.2.1 The National Curriculum, Textbooks and National Standardised Tests

The first data gathering technique used in this study to contextualise my study was to analyse documents, including the National Curriculum, Natural Science and Health Education mainly used by teachers and the SATs report of 2015.

1.2.1.1 The National Curriculum for Basic Education Syllabus Grades 5-7, and textbook

The NCBE (2010, p.12) "wants learners to develop knowledge, skills and attitudes to manipulate and relate to the natural environment in the value-framework of the sustainable use of matter, energy and processes in living and non-living things." The curriculum does not mention water conservation in particular, but notes that learners should use resources in a sustainable way.

1.2.1.2 Natural Science and Health Education Syllabus Grades 5-7

The syllabus is systematically divided into three columns, indicating the theme/topic, learning objectives and basic competencies for each topic. Theme 4.5 deals with water pollution and purification of contaminated water.

The table below gives the layout of the basic competencies of this topic in the syllabus:

Table1.2.1.2: Basic competencies for the topic Water as laid out in the Natural Science and Health Education syllabus for Grade 6

THEMES AND TOPICS	LEARNING OBJECTVES: Learners will:	BASIC COMPETENCIES: Learners should be able to:
4.5 Water pollution and purification of contaminated water.	understand the need to conserving clean water in their locality (home and school)	• describe ways of conserving water • explain the importance of conserving water

While it is encouraging to find that the basic competencies describe and explain water conservation, it does not require learners to apply it in their daily lives at school and home.

1.2.1.3 Textbook: Platinum Natural Science and Health Education Grade 6

This textbook is currently used by schools in the Walvis Bay circuit. It introduces the topic on water conservation with the importance of conserving water. Insertions encourage active interaction and dialogue between learners and the teacher as an approach to the mediation of learning of the topic. Examples are given below:

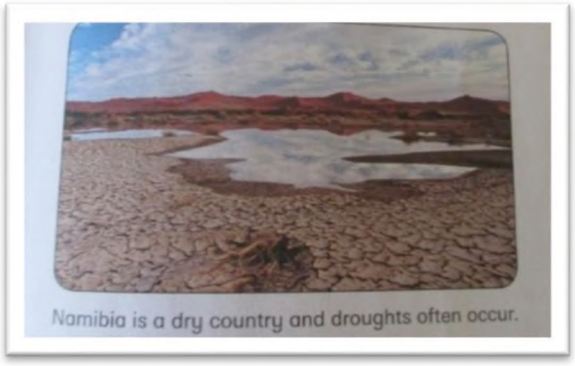
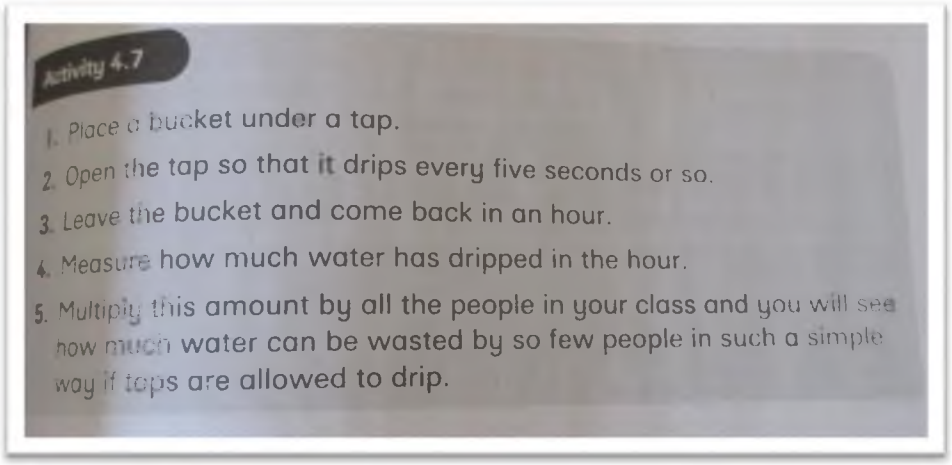


Figure 1.2.1.3 (a): It encourages active interaction and dialogue because it shows the Namibian dry conditions



Activity 4.7

1. Place a bucket under a tap.
2. Open the tap so that it drips every five seconds or so.
3. Leave the bucket and come back in an hour.
4. Measure how much water has dripped in the hour.
5. Multiply this amount by all the people in your class and you will see how much water can be wasted by so few people in such a simple way if taps are allowed to drip.

Figure 1.2.1.3 (b): Shows an activity which demonstrates how leaking taps can be very costly and why we need to conserve water at home and school

This textbook, brings forth the basic competencies as set out by the syllabus and is user-friendly, but it does not look at how the learners and community members can collaborate in solving water problems.

1.2.1.4 Standardised achievement tests report

The first national Standardised Achievement Tests (SATs) were introduced in 2010 as an attempt to show teachers how learners were learning, achieving, and to provide a basis for teachers to reflect on their teaching practices. A study conducted by Shaakumeni (2012) indicated that teachers were not using the SATs reports diligently in their planning of teaching and learning activities. With regard to my study, it will give an indication how the topic water conservation was covered and assist teachers on improving areas in which learners did not answer well. Diagnostic reports were the products of the testing. The data obtained from the analysis of the tests results were used in establishing a baseline for monitoring the progress of schools over and to assist teachers with the identification of problem areas where learners were experiencing difficulties with the mastery of the key skills and competencies specified by the Namibian syllabi. With regard to my research, I will be looking at the reports of the SATs to see how much emphasis was put on the inclusion of the topic water conservation during the tests. There are two SATs reports that each school receives. One is quantitative and the other is qualitative. The quantitative section gives the overall performance comparison of the school, region and national in percentage scores while the qualitative section gives the competency-based description of the performance level categories.

For illustration in this study, a simplified extract of the quantitative sections of the report is shown in Table 1.2.1.4 (a) to show how our learners performed on the topic water conservation and our region in particular. The Erongo region, performed above the National score, but below the Regional score. The report further indicates that the topic water conservation is covered by the Standardised Achievement test as they see it as important.

Table 1.2.1.4: Quantitative section showing percentage scores

		Cognitive level	**National % Scores**	**Erongo Regional % Scores**	**School % Scores**
Competencies	Explain the importance of water conservation	Application	48	57	55

The above table shows the key information that the report seeks to communicate: percentage scores per competency as it appears under national and regional groups, and individual schools. The competencies are as they appeared in the Natural Science syllabus. See attached SATs results on how the topic water conservation is covered and answered (Appendix 5).

1.3 Statement of the problem

My interest in the topic of water conservation was triggered when the Ministry of Education in Namibia introduced the water, sanitation and hygiene (WASH) program in 2014 initiated by United Nations International Children's Emergency Fund (UNICEF). The program was introduced because water, sanitation and hygiene are linked to many diseases that kill children or stunt their development according to UNICEF (2006). Taking into consideration that we are living in a sub-Saharan country with low rainfall, I realised that the WASH program could lead to water being misused in both schools and in the homes if not properly monitored. This means that the Ministry of Education should hold schools accountable for their high water bills and also demand that schools submit policies on how they save water. With the Ministry of Agriculture, Water and Forestry and the Ministry of Education promoting conflicting messages about water, one to conserve it and the other to use it more, one of the objectives of the Ministry of Agriculture and Water Affairs is “to improve the provision of sanitation services in order to promote the conservation of water” (p. 4).

What further prompted me to integrate indigenous knowledge in my science lessons is that as an African boy growing up I only met a real medical doctor when I was 10 years of age. Most of my ailments, I am told, were treated by my grandmother using traditional medicine. That is why I agree with scholars such as (Corsiglia & Snively, 2001; Kawagley, Norris-Tull & Norris-Tull, 1998) who state that there are many ways of knowing, as they advance the notion that school science, which originated in Western culture, is not the only way of making sense of the world.

As stated in my epigraph, I further agree with statements made by Shizha (2006, p. 32), who claims that "science has borrowed its knowledge from indigenous knowledges; and hence the inclusion of indigenous knowledges in the science lessons is a form of reconciliation and social justice that empowers the peoples by providing a voice to teachers, learners, and other community stakeholders interested in the education of their children".

Many community members, especially the Topnaar community living at Utuseb, a rural settlement of about 400 people, 100km from Walvis Bay, have been living in a desert environment and have survived for millennia with little available water and with a minimal use of water. This suggests that they may have extensive and valuable local knowledge that could play a vital role in making the concept of water conservation clearer to learners and also open up to them and the rest of us new ways of conserving water in this context. Yet, there is to date no visible effort from the Ministry of Education Arts and Culture (MoEAC) to tap into this local rich knowledge base and bring it into the mainstream school curriculum, as it is not yet reflected or recognized in our syllabuses. This is despite the fact that the curriculum encourages teachers to adapt a learning and teaching approach that "recognises the fact that learners bring to the school a wealth of knowledge and social experience gained continually from the family, the community and through interaction with the environment" (MoEAC, 2015, p. 3).

The inclusion of IK in Natural Science as a subject in the Namibian context is still under-researched. While research in Namibia on the topic is growing with great interest from researchers, there are still gaps that need to be explored. Thus, this research sought to understand how two Natural science teachers included indigenous knowledge in the teaching of the topic water conservation.

1.4 Significance of my study

Little research is available in Namibia on the inclusion of indigenous knowledge when teaching water conservation in particular. This study may hopefully be foundational in identifying some of these local practices that could be included in the classroom curriculum and also highlight some strategies on how to make sense of water conservation through the inclusion of indigenous knowledge. Furthermore, this study may hopefully lay the foundation for further work that could include the development of teaching aids and creative worksheets, lesson plans and practical activities to assist teachers in their mediation of learning of the topic water conservation with the inclusion of indigenous knowledge at Grade 6 level. Lastly, with information gained from the study, I hope to contribute to primary school Natural Science teachers' as well as student teachers' effective learning of the topic conservation through the inclusion of indigenous knowledge.

The study is informed by Vygotsky's (1978) socio-cultural theory in conjunction with Shulman's (1986) pedagogical content knowledge (PCK). Since a classroom is a social unit where interactions occur between teachers and learners, and learners and learners, these theories provided a useful lens for observing lessons and analysing teachers' content knowledge and how they mediate learning using local indigenous knowledge.

1.5 Research goal and questions

The main goal of my study was to explore the possibility of integrating local indigenous knowledge in the teaching of the topic of water conservation by senior primary school Natural Science teachers. The objectives of this study are:

- To identify, in collaboration with two teachers, some of the local indigenous knowledge about water conservation possessed by members of Topnaar community;
- To explore ways of integrating the local indigenous knowledge into the teaching of the topic of water conservation in Grade 6;
- To collaboratively identify factors that enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge.

To achieve the goal and objectives of my study the following questions guided the study:

Main Research Question

How can two Grade 6 Namibian Natural Science teachers use local indigenous knowledge to mediate learning of the topic water conservation?

Sub-questions

1. What local indigenous knowledge on water conservation is found in the Namibian Topnaar community?

[To answer this sub-question I prepared and discussed the interview questions with the natural Science teachers before we interviewed people from the Topnaar community. Together with the two teachers we also observed local practices on water conservation in the Topnaar community]. See Appendix 1.

2. How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water?

3. What factors enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge?

[To answer these two sub-questions, I worked collaboratively with two Natural Science teachers in planning lessons, had group discussions and I used Stimulated Recall Interviews (SRI) to show factors that enable or constrain the mediating of the topic water conservation using local knowledge. I also observed, video recorded lessons and interviewed the two Natural Science teachers (see Sections 4.4 and 3.6.2).]

I will use document analysis (Curriculum documents) to contextualize my study (see Section 1.2.1). For my main study, however, I used observations and semi-structured interviews as outlined in Table 1 (see Section 3.6).

1.6 Thesis outline

The thesis has six chapters and the outline of each chapter is given in detail below.

Chapter 1: Situating the study

This chapter outlines the research context. The aims and the significance of the study is also illustrated in this chapter. Furthermore, this chapter gives the reader a clear view of the research by outlining the research goal and research questions. Lastly, the definitions of concepts are provided in this chapter.

Chapter 2: Literature Review

This chapter articulates the overview of the literature review that informs my research by focusing on curriculum view on teaching using LCE in Namibian context and the Namibian Standardised Achievement Tests. The literature used was based on the concept of indigenous knowledge (IK); as well as the theoretical frameworks used in the study, namely, Vygotsky' social cultural theory in conjunction with Shulman's pedagogical content knowledge (PCK). I end this chapter with some concluding remarks.

Chapter 3: Research Methodology

According to Leedy and Ormrod (2010, p. 12), "Research methodology is a general approach the researcher takes in carrying out the research". This chapter will narrate the methodology used to collect data for my research. In this chapter I pointed out the type of my research as within the interpretive paradigm where I will carry out a qualitative case study. It also clarifies the methods used to gather data to answer my research question. The methods of data generation such as, interview (semi-structured interview) and observation are discussed in more detail in this chapter. It is in this chapter where the sampling of participants for both observation and interviews are described. The chapter concludes with Triangulation methods used to validate the data and the ethical consideration taken by the researcher. It also highlights some limitations that occurred during the data generation methods.

Chapter 4: Data presentation, analysis and discussion

In this chapter, I give a detailed narrative of the data generated by through observation and interview (semi-structured interview) with Topnaar community members. The presentation is from participants own words and direct quotes are included. This chapter will also highlight the emerging categories that will be grouped into themes that will be link to the theory (socio-cultural perspective) I am using to answer my research question 1.

Chapter 5: Data presentation, analysis, and discussion

In this chapter, the data presented in chapter 5 are critical analysed and categorized into categories to be examined by the means of theoretical framework and literature. The findings of the research is presented in relation with the literature in chapter 2. The data is dismantled and categorized into categories to form themes (analytical statements) that emerged in chapter 5 to answer research question 2 and 3. During the data discussion, a meaningful attempt is made to make new knowledge in relation to the research question in chapter 1. The data categorized into themes and literature will be linked to the theory I am using to create new and meaningful knowledge in the Namibian context.

Chapter 6: Summary of findings, recommendation and conclusion

In this chapter, the summary of the findings, recommendations, reflections and conclusion are summarized in detailed from chapters 1 to 5. It highlights the findings of the research, makes recommendations about the area of future research and reflects on the overall research process. It also includes the limitations of the research.

1.7 Concluding remarks

In this chapter I look at the context and the background of my study in the Namibian context. The chapter also presents the research questions of my thesis, goals of the study, data generating techniques, the definitions of concepts used in the thesis, and the chapters in this study are outlined. The potential value of the study is outlined.

The next chapter provides the review of literature on the inclusion of local/tradition knowledge (indigenous knowledge) in the teaching on the topic water conservation.

CHAPTER 2: LITERATURE REVIEW

> *If each child is unique, and each requires a specific pedagogical approach appropriate to him or her and to no other, the construction of an all embracing pedagogy or general principles of teaching becomes an impossibility (Simon, 1999, p. 42).*

2.1 Introduction

The main goal of my study was to explore the possibility of integrating local indigenous knowledge into the teaching of the topic on water conservation by senior primary Natural Science teachers. This chapter seeks to clarify the concepts or ideas that shape the thinking about the research and research processes. The chapter discusses what constitutes local/traditional knowledge (indigenous knowledge) as well as how it is critically relevant to the human pursuit for sustainable living on earth. It further probes into how Indigenous Knowledge (IK) and Education for Sustainable development (ESD) relate to the Namibian Science curriculum. The chapter further discusses socio-cultural learning and Pedagogical Content Knowledge (PCK) as the theoretical lenses that were used to analyse and make sense of the data.

2.2 The Namibian Science Curriculum and Learner Centred Education

Before independence in 1990, when Namibia was still administrated by South Africa (RSA), most Namibian schools followed the Cape Province syllabus and examination structure (Olivier, 1994, p.1-2). After independence in 1990, the education processes in Namibia changed from teacher-centred education (TCE) to learner-centred education (LCE) and this is documented in a range of documents (Toward education for all, 2008), Namibia, Ministry of Basic Education and Culture (NMBEC), 2010 & National Institute for Educational Development (NIED), 1999).

To understand the teaching of any subject content in the Namibia education system, one must first recognize the learner-centred pedagogy that underpins it. Pomuti, LeCzel, Liman, Swarts and van Graan (2003) suggest that the entire education system had to undergo a major overhaul in line with the post-apartheid political imperatives of *access*, *equity*, *quality* and *democratic* participation. This suggests that there was a need for a paradigm shift from content-based and teacher-centred system for a few privileged learners, to a learner-centred system for all.

Teacher-centred education was more focused on the teachers, syllabuses, and textbooks without considering the knowledge the learners brought from home into the classroom (Namibia. MEC, 1993, p.6). In contrast, LCE entails teaching and learning processes which focus on what the learners should know, understand, do and be able to become as opposed to what the teacher should achieve. Nyambe (2008) further argues that, unlike TCE, the aim of LCE is to put learners as the focus of teaching and learning. That is, learners are seen as central in the learning process.

In 2010, the Ministry of Education (MoE) in Namibia introduced the National Curriculum for Basic Education known as Curriculum 2010. The NCBE (2010, p.6) "sees Namibia as developing from a literate society to a knowledge-based society, a society where knowledge is constantly being acquired and renewed, and used for innovation to improve the quality of life." This means that the NCBE encourages teachers to use different knowledges. Indigenous Knowledge (IK), experiences and Western Science (WS) are some of the sources teachers should embrace and use to the advancement of learning and teaching.

According to Kibirige and Van Rooyen (2006), the science textbooks used in school science curricula sometimes do not consider indigenous knowledge or other forms of knowledge. Concurring, Milne (2011) adds that IK is diminished or considered of lesser value. Thompson (2012) reasons that the use of IK can sometimes promote socio-cultural and constructivist theories of learning if used in the classroom and can enable the constructivist theory to be implemented and is thus suitable to use as a tool to culturally explain learner-centred approach.

It is not clear from the curriculum documents how local/traditional knowledge (indigenous knowledge) is supposed to be included in the science lessons to make meaningful teaching and learning. Thus, viewed from a social constructivist perspective, a learner-centred curriculum involves recognition of the role played by learners' sociocultural contexts in shaping the knowledge and worldviews that they bring into the classroom (Vygotsky, 1978; Wertsch, 1985). Learners are therefore active participants of knowledge construction of their own, if given the chance to do so.

In the policy for LCE by NIED (1999), LCE is defined as 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 whatever needs the teacher has decided upon. This suggests that activities which put the learner at the centre of teaching and learning should begin by using or finding out the learners' existing knowledge, skills and understanding of the topic. Additionally, 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. This is what learner-centred pedagogy requires learners to do in the classroom situation. Furthermore, LCE calls for the inclusion of local/traditional knowledge (indigenous knowledge (IK)).

However, learner-centred learning, despite its attractiveness, is not without its critics. As stated in my epigraph, the main critique of learner-centred learning is its focus on the individual learner (Simon, 1999). Simon (1999) also suggests that learner-centred learning in schools can be at the risk of focusing completely on the individual learner and, taken to its extreme, does not take into account the needs of the whole class. Simon highlights the point that:

> If each child is unique, and each requires a specific pedagogical approach appropriate to him or her and to no other, the construction of an all embracing pedagogy or general principles of teaching becomes an impossibility (Simon, 1999, p. 42).

Another risk that impedes learner-centred education is when a learner is empowered, there is a danger of a learner's physical isolation from other learners (O'Neil & McMahon, 2005). A further criticism is the belief that students who value or have experienced more teacher-centred style of learning, may reject the learner-centred style as being frightening or indeed not within their sphere of activity. O'Sullivan (2003) described learner-centred learning as a Western approach to learning that may not necessarily transfer to developing countries, such as Namibia, where there are limited resources and different learning cultures. Nyambe and Wilmot (2012) in their research on how teacher educators in a Namibian college interpret and practice learner-centred education came up with the following findings:

- Contradictions not only between teacher educators' ideas of learner-centred pedagogy and their practice of it, but also within official pedagogic texts; and

- Teacher educators are told to change their classroom practice and to adopt learner-centred pedagogy as the new approach in post-apartheid Namibian classrooms while at the same time there is still official clinging to traditional pedagogic structures and arrangements that are antithetical to the new pedagogy.

In the next section I will focus on conceptual framework and on how best IK can be used in the teaching science lesson.

2.3 Conceptual framework

Regoniel (2015) states that a conceptual framework represents the researcher's synthesis of literature on how to explain a phenomenon. It maps out the actions required in the course of the study given his previous knowledge of other researchers' point of view and his observations on the subject of research. The conceptual framework for my study is influenced by the United Nations Sustainable Development Goals 4 which states that, "*to ensure inclusive and equitable quality education and promote lifelong learning opportunities for all"* and Goal 6 *"to ensure availability and sustainable management of water and sanitation for all*". It is furthermore influenced by researchers such as (Kibirige, & Van Rooyen, 2006; Mapara, 2009; Mukwambo, Ngcoza, & Chikunda, 2014; Ogunniyi, & Ogawa, 2008; Shizha, 2007), all of whom have endeavoured to conduct research on the inclusion of indigenous knowledge in the school curriculum. Prior knowledge can be thought of as students' experiential knowledge. There are various forms of knowledge students can gain from living and working in their communities, their homes, or from other local activities. Educational research has shown that teaching supported by prior knowledge increases students' ability to grasp material taught to them (Jegede, 1999, p. 119).

2.4 The role of prior knowledge in learning science

I opine that for improved concept development and topic sense-making to take place, teachers need to make use of different forms of mediation. Other than language clarifications and explanations, the use of prior and everyday knowledge can assist learners' progress better in conceptual development.The National Curriculum for Basic Education (NCBE, 2010) states that learners are not empty vessels and instead they already possess a variety of experiences when they come to school. Good learning practices start from learners' previous experiences before engaging in new, often more intricate experiences. Constructivists believe that all learners can only manage to create

new understandings or meanings based on what they have previously experienced. The nature of meanings and understanding of concepts are all influenced by the previous experiences on which they interpret new experiences. Teachers are, therefore, compelled to consider and draw on learners' prior knowledge before introducing new concepts to them (Roschelle, 1995). Teaching that does not build on the learners' experiences does not make them see the connection between the world outside the classroom and what is taught in school (Oloruntegbe & Ikpe, 2011; Stears, Malcolm & Kowlas, 2003).

Nyambe (2008) also urges teachers, from a learner-centred perspective, to structure their lessons in ways that facilitate and encourage active learner participation and involvement in the pedagogic process. This agrees with policy in education for all (Namibia, MEC, 2008) states that:

> Our teaching methods must allow for the active involvement and participation of learners in the learning process. Teachers should structure their classes to facilitate this active learner role. Often, that will mean organizing learners in smaller or larger groups, or in pairs, or working with them individually. It will mean as well using teaching techniques that fit the purpose and content of the lesson and that at the same time encourage active learner participation, for example, explaining, demonstration, posing questions, checking for understanding, helping, providing for active practice, and problem solving (p. 60).

Teachers in learner-centred education need to arrange their classrooms in such a way that learners are in groups in order to allow them to share ideas and help one another during the lessons. Teachers need to mediate learning by creating the opportunity from which learners can construct their own knowledge.

This is crucial in science classrooms, where the main object of learning is to understand natural phenomena in the environment or creating new materials that exist therein (Geelan, 1997). The NCBE highlights that "learning in school must constantly recount to, involve, and encompass the learners' prior knowledge and experience, and this must be complemented and challenged by the knowledge that the school provides from beyond the immediate scope of the learner" (MoE, 2010: 30).

To help learners make the most of the new experience, teachers need to understand how prior knowledge affects learning. For this reason, science teachers need to incorporate learners' prior

knowledge into their lessons to enhance learners' acquisition of the subject matter. In this study, the incorporation of indigenous knowledge in the teaching of water conservation.

However, Taylor (1999) argues against the notion of using everyday knowledge. He warns of a naïve application of the emphasis on local knowledge in the hands of a teacher without solid conceptual frames, where 'school knowledge is totally submerged in an unorganised confusion of contrived realism' (Taylor, p. 121). Thus, teachers cannot simply allow learners free rein in discussing any everyday example in the hope that this will inevitably lead to the attainment of refined concepts. He reasons that some of these perspectives can be misleading and counterproductive to learning.

Maselwa and Ngcoza (2003), in their overview of OBE and the Curriculum 2005, concur with (Oloruntegbe & Ikpe, 2011; Roschelle, 1995; Stears, et al., 2003) with regard to the use of prior everyday knowledge and experiences of learners in science teaching. They specified that the OBE philosophy like learner-centred education (LCE) is adopted from the social constructivist theory of teaching and learning. The C2005 curriculum strives towards teaching that is more learner-focused, using constructivist methods and based on work which is relevant to the learners' lives. The OBE curriculum also strongly encourages 12 skills-based education which underlines the development of relevant competences such as skills, knowledge, attitudes and values on the learners (Maselwa, 2004).

Thus, from the constructivist point of view, the outcomes stated above are believed to be constructed through engaging learners' prior everyday knowledge and experiences in the atmosphere of cooperative learning. If teachers are likely to involve learners in cooperative learning, then they need to be equipped with proper pedagogical strategies to empower them to change the manner in which they teach, especially when it comes to the inclusion of IK in the teaching of the topic water conservation.

2.5 Indigenous Knowledge (IK)

Indigenous knowledge has become a growing field of inquiry, both nationally and internationally, particularly for those interested in educational innovation. The question "What is indigenous

knowledge?" is usually asked by modern western scientists seeking to understand a rationale that is unfamiliar to them.

Teachers, who largely depend on knowledge that they learned from college, dealing with indigenous knowledge may regard it as an alien concept. In other words, ordinary minds do not usually worry about processes that shift the position of things in a society. Thus, I consider it necessary to clarify some meanings that surround the terms 'indigenous' and 'knowledge,' to clear any misconceptions.

2.5.1 Meaning of Indigenous

The meaning, as interpreted by colonialists during colonialism era, was associated with the primitive, the wild, the ignorant, and the natural. An element that postcolonial theorists reveal to be a causal factor that leads to little appreciation of indigenous insights and understandings that indigenous people offered to the colonial masters' pool of knowledge (Carter, 2006; McKinley, 2005; Semali & Kincheloe, 1999). However, Apusigah (2012) in her study on indigenous knowledge, cultural values and sustainable development in Africa states that "the re/turn to culture for sustainable solutions has led to the re/valorisation of indigenous peoples worldviews" (p. 3). This means there is an awareness amongst governments about the value indigenous worldviews can offer to natural resource management and social well-being improvement amongst others.

Because of this lack of consensus, the United Nations has not adopted a singular definition of who is 'indigenous', but has compiled a list of descriptors that provides an inclusive understanding of the term, based on:

- Self-identification as indigenous peoples at the individual level and accepted by the community as their member;
- Historical continuity with pre-colonial and/or pre-settler societies;
- Strong link to territories and surrounding natural resources;
- Distinct social, economic or political systems;
- Distinct language, culture and beliefs;
- Form non-dominant groups of society; and
- Resolve to maintain and reproduce their ancestral environments and systems as distinctive

peoples and communities.

United Nations (2006, p. 41)

Turnbull (1997) views knowledge as a socio-cultural and historical construction in which societies are capable of producing knowledge, but there are expected cross-cultural variations in the way in which knowledge is assembled and disseminated. He further clarifies that some traditions move it [knowledge] and assemble it through art, ceremony and ritual; [Western] science does it through forming disciplinary societies, building instruments, standardization techniques and writing articles. In both cases it is a process of knowledge assembly through making connections and negotiating equivalences between the heterogeneous components while simultaneously establishing a social order of trust and authority resulting in a knowledge space (p. 553).

Most definitions share many similarities and cover some aspects of Indigenous Knowledge. For example, comparing the following three typical broad definitions from Warren (1991, 1992), Flavier (1995), and Ellen and Harris (1996): Indigenous knowledge (IK) is the local knowledge – knowledge that is unique to a given culture or society. IK contrasts with the international knowledge system generated by universities, research institutions and private firms. It is the basis for local-level decision making in agriculture, health care, food preparation, education, natural-resource management, and a host of other activities in rural communities (Warren, 1991, p. 479)

Indigenous Knowledge is the information base for a society, which facilitates communication and decision-making. Indigenous information systems are dynamic, and are continually influenced by internal creativity and experimentation as well as by contact with external systems (Flavier, 1995, p. 479)

IK is local *environmental* knowledge (knowledge of plants, animals, soils and other natural components) with *practical* applications, rather than the more encompassing sense of IK associated with environmental philosophies or world-views, or even ITK (indigenous technical knowledge) in its wider sense (Ellen & Harris, 1996, p. 1). However, we accept that such practical, technical and empirical knowledge is characteristically embedded, linked to, and informed by these broader understandings. It is assumed that most readers will already be persuaded that

indigenous environmental knowledge (hereafter IK) can hardly be ignored in development contexts, as well as having applications in industry and commerce (ibid).

According to Warren (1991, 1992), Flavier (1995) and Ellen and Harris (1996), indigenous peoples throughout the world have sustained their unique worldviews and associated indigenous knowledge systems for millennia, even while undergoing major social upheavals as a result of transformative forces beyond their control. Many of the core values, beliefs and practices associated with those worldviews have survived and are beginning to be recognized as having an adaptive integrity that is as valid for today's generations as it was for generations past. The depth of indigenous knowledge rooted in the long inhabitation of a particular place offers lessons that can benefit everyone, from educator to scientist, as we search for a more satisfying and sustainable way to live on this planet.

Indigenous knowledge can therefore be broadly defined as the knowledge that an indigenous (local) community accumulates over generations of living in a particular environment. This definition encompasses all forms of knowledge – technologies, know-how skills, practices and beliefs – that enable the community to achieve stable livelihoods in their environment.

Indigenous knowledge is a legacy of knowledge and practice unique to a particular indigenous group of people, practices that has been developed and passed on over generations (Kibirige & Van Rooyen, 2006). Mapara (2009) define indigenous knowledge systems as a body or bodies of knowledge of indigenous people of specific geographical areas that survived for a long time and practice unique ways of doing things. Examining various cultural indigenous groups in Namibia, one clearly is able to point out unique practices within various indigenous groups.

Indigenous knowledge is characteristically orally produced from everyday experiences (e.g. hunting, fishing, farming, and social interactions such as music) of all people in a community that are shared as narratives representing myths, beliefs, ceremonies, and pragmatic practices. Some narratives involve accurate observation and inquiry but others are from past experiences. Hence, indigenous knowledge is produced differently from science. A major distinguishing characteristic of indigenous knowledge is that it is handed over from one generation to the next (Kibirige & Van

Rooyen, 2006; Ocholla & Onyancha, 2005).

2.5.2 Production and conservation of Indigenous Knowledge

According to Ocholla and Onyancha (2005, p. 248), "indigenous knowledge is tacit or tangible knowledge which is inseparable from realistic knowledge". This means that indigenous knowledge is produced in an ongoing manner and accumulated from everyday experiences. Revision of knowledge is ongoing and people accomplish this through direct use of knowledge. According to Ocholla and Onyancha (2005), all people, both young and old, are actors in the indigenous knowledge production. They delight over the fact that indigenous knowledge has recently been brought back to the people because of interventions by governments and civil societies through legislation and policies that pertain to intellectual property rights, research, alternative medicines and nutrition. These developments influence the doubts that increasingly rose up due to globalisation pressures and also increasingly fostered melting down of indigenous knowledge. (Ocholla & Onyancha, 2005, p. 248). It is evident that opportunities to preserve and value indigenous knowledge are endangered by the range of problems within our environment and communities today. Opportunities for the preservation of indigenous knowledge are fading and are at risk of being lost altogether. Loss of indigenous knowledge will result in a decline of indigenous identity and a severe reduction in the recognition and understanding of an invaluable sustainable knowledge system.

A language (oral or written) is not only a means of communication between members of a community. Instead, it also contains within it the heart of considerable information and knowledge and wisdom of the people or community. Its loss is therefore a loss of IK. The threat is greatest in the case of IK that has been passed down and evolved orally, since it disappears with every generation that has not been able to hand it down to the next one (Kothari, 2007, p.7). As the peoples and communities holding IK themselves face a range of threats from outright extinction to 'integration' into 'conventional' society, the knowledge they hold also slips away. A clear and alarming indicator is the threat to languages, with some scholars estimating that half of the around 6,000 languages spoken today may become extinct by 2050 or 2100 (ibid).

Reynar (1999) deliberates how indigenous knowledge has kept evolving and improving to the

extent that the past fifteen years have noted an increase in indigenous knowledge systems. This is observed through an impressive increase of literature (Ocholla & Onyancha, 2005), thereby signifying that indigenous knowledge has the capacity for adaptation. Despite this, however, science teachers are still grappling with how to integrate IK in their classrooms.

2.5.3 Teachers' Knowledge about Indigenous Knowledge

Shumba (1999) carried out a quantitative research study in Zimbabwe, the objective of which was to measure the extent to which secondary science teachers were oriented towards traditional culture and how their orientation towards indigenous culture was related to instructional cultural ideological preferences. Shumba's (1999) study design assumed that teachers' commitment to indigenous cultural values and beliefs would bear a relationship with their instructional ideology preferences. The study found that secondary school teachers were not strongly traditional, but maintained a fairly traditional posture with regards to aspects of traditional authority, religion, view of nature, and social change. Additionally, the study revealed that secondary school teachers shifted further off from tradition with regards to sex roles, causality and problem solving. In summary, this study revealed a transformation of secondary school teachers in Zimbabwe (a former British colony) that led to loss of some traditional values.

On the point of methodology, Shumba (1999) realized that the instruments for validating cultural tenets need to be improved and that the next study could include observational data collection instead of sole reliance on thematic categories whose occurrence rates determined the prevalence of characters under study. These results were not really strange because Michie (2002) also pointed out that teachers, especially in secondary schools, tend to lack knowledge about indigenous science. This is why teachers are encouraged to conduct research in communities surrounding their schools as a way of upgrading their background knowledge in indigenous knowledge as also recommended by Gonzalez, Moll and Amanti (2005). Michie (2002) further contends that secondary schools might not be a good sites for indigenous knowledge since the content, at that level, is more compartmentalized than holistic. For Michie, the best site for indigenous knowledge is primary schools, which tend to have integrated curricula.

Klein (2011), in his study in the south of Namibia amongst the Nama people, revealed that teachers

can complement their formal teaching by including local knowledge of local community members in subjects such as Natural Science in primary schools and Life Science, Physical Science and Biology in secondary schools. However, according to Mukwambo, et al. (2014), most science concepts are not yet developed in the indigenous language and science concepts are not always explicit in most indigenous practices, yet the Africanisation of the school science curriculum calls upon the teachers and learners to attach scientific 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.

2.5.4 Indigenous Knowledge in relation to Science

Turnbull (1997) persuasively illustrated that recent times are witnessing a definite change about the status of Western science and that this is apparently registered by "mainstream, orthodox, historians and sociologists of science, whose attitudes are generally changing their minds" (p. 551). The change indicates a growing recognition that there are other ways of knowing the world in addition to the European scientific way of knowing, formerly considered as universal. According to Turnbull (1997), this change arises from critiques of science by "sociologists of scientific knowledge, feminists, post-colonialist, and socialists" (p. 551). The table below is an indication how indigenous knowledge relates to Science.

Table 2.5.4: Indigenous knowledge in relation to Scientific Explanations

Indigenous knowledge	Process	Scientific explanation
Processing of cassava	Combination of drying, soaking, boiling, grating (and pressing), fermentation Avoiding consumption of bruised cassava, "it increases the chances of stomach problems"	Detoxification with regard to residual cyanogenic glycosides) Bruising exposes tissues to oxygen, which leads to hydrolyses of cyanogenic glucosides to hydrocyanic acid (HCN) by endogenous enzyme Linamar's. It is HCN, which causes stomach problems and sometimes death.

Germination of cereals	Gelatinization of starch and let to cool for 12 hours. Then dilute to drink.	Increased content of water – soluble vitamins and amino acids such as lysine and methionine and of soluble sugars in the malt.

Adapted from Mwadime (1999, p. 257)

Among the arguments raised is the fact that the kind of knowledge which is recently called 'modern science' is a relatively recent local activity that was co-produced with industrial capitalism and more importantly, "science in the general sense of systematic knowledge was never uniquely Western, having its origins in a wide variety of cultures including Islam, India, Africa and China" (Turnbull, 1997, p. 552). In other words, indigenous groups of people as well are recognized to have some scientific knowledge, but acceptance of the array of such knowledge in the standard account is a great struggle. The problem related to the recognition of knowledge is in the way it is produced. This suggests that there is a need to value indigenous knowledge include it in the curriculum.

The curriculum is the official policy for teaching, learning and assessment and gives direction for planning, organising and implementing teaching and learning (The National Curriculum for Basic Education (NCBE), 2010, p. 1). The National Curriculum for Basic Education emphasise LCE, as an approach to teaching and learning (NCBE, 2010, pp. 26-27). Nyambe (2008) indicates that in Namibia learner-centred pedagogy means a democratic pedagogy that is flexible, where teaching and learning is responsive to the learning needs of individual learners in terms of learning content, methods of instruction used and pacing, the time given to the learners to construct their own knowledge.

One of the aims of the NCBE is to develop an environmentally sustainable society (NCBE, 2010, p. 8). The aims of the curriculum in relation to developing an environmentally sustainable society are to provide the scientific knowledge and skills, and attitudes and values needed to ensure that the environment is respected and sustained; and to develop the ability to make environmentally wise choices in terms of family development, as well as in economic activities. Looking at the above statements and on how we, as the Namibian nation, can reach the SDG goals (4) and (6) of

the United Nations which focus on quality education and sustainable water management, the need of the inclusion of indigenous knowledge (local knowledge) in the Science Curriculum to create an environmentally sustainable society becomes an utmost importance.

For instance, the importance of sufficient clean water in the Grade 6 science textbook (Elphick & Mackenzie, 2015) deals with health problems found in Namibia related to the scarcity of clean water and the need to conserve clean water in their locality (home and school). Communities such as the Topnaars have long employed IK to ensure that their resources are not over-used. For example, there is a strong belief in their community that "*one must never cut trees near a river or along the banks because it discourages rain and the river will dry up*". For years, through following this belief, the community has managed to maintain their water resources.

McCallum (2012, p. 12) gives the following reasons why students and future generations may benefit from incorporating indigenous knowledge into the Science Curriculum. The following is applicable to my study:

a) Indigenous Knowledge is inextricably linked to global sustainability. Our planet is facing ecological crises as a result of globalization. IK has valuable insights to implementing efficient uses of our land and spiritual relationships with nature. Educators can implement many of these insights into teaching practice;
b) Students can be taught to sustain life and protect our planet, not exploit it. Conservation of energy and resources, and learning about sustainability is essential to teach our children now, so that they can pass along to future generations;
c) Indigenous Knowledge and Western Knowledge can be taught together. Indigenous and Western philosophies, beliefs, and spirituality do not need to be taught in opposition, or in isolation. It is only when we can teach our students to understand themselves and the world around them, that we can create true empathy, understanding, and hopes for the future of our planet.
d) Educators can strengthen the capacity of local communities and other counterparts to participate in the conservation management of resources; and
e) Integrating IK into Science Curriculum right now is a great place to start to help improve our planet and environment for the next generations. This rests now with the National

Council for Indigenous Knowledge System (IKSC) which was established in 2014 in Namibia, to facilitate the developmental agenda related to Indigenous Knowledge System in all sectors including Education.

2.5.5 Some examples of IK being successfully incorporated into the teaching and learning of science in Namibia

In Namibia, ethnic identity is stronger than national identity, with 75% of Namibians feeling much stronger ties to people of their own ethnic group than to fellow compatriots of other ethnic groups (Shaw-Taylor, 2008). This indicates that that a lot of indigenous knowledge is embedded within these ethnic and cultural groups. Over the past two decades the Namibian policy-makers and knowledge developers have begun to realise the importance of indigenous knowledge in the country's development process (Chinsembu & Hamunyela, 2015). They agree that indigenous people have a broad knowledge on living sustainability. However, they are disappointed that formal education systems have disrupted the practical, everyday-life aspects of IK and ways of learning, and replaced them with abstract knowledge and academic modes of rote learning.

It is therefore important that learners' everyday experiences can best be valued if the teachers know what direction to proceed in. Stears, et al. (2003) suggest that teachers and curriculum designers should work together to write materials that are culturally relevant. Their research findings also suggest that teachers should plan activities carefully to link them with learners' everyday experiences.

It is acknowledged, however, that a teacher needs to be knowledgeable if she is to start a lesson by referring to learners' context. Klein (2011), in his research findings amongst the Nama people in the south of Namibia, revealed that it is possible to integrate IK in the schools by drawing on the skills and knowledge of parents and grandparents. His research, focusing on the indigenous cultures skills and knowledge, resulted in better school performance, reduced dropout rates and fewer disciplinary problems amongst learners. This is in agreement with the principles of Ubuntu which include: respect for other cultures, relatedness, communalism, interdependence, supportiveness, solidarity, cooperation, caring for others, kindness and neighbourly support (Broodryk, 2012; Hamminga, 2005; Le Grange, 2012; Louw, 2004; Malcolm & Alant, 2004).

Maselwa (2004) suggests that teachers need to be knowledgeable about the subject content and mindful of the elicitation and incorporation of learners' experiences into their teaching and learning practices. This enables the teacher to help learners develop scientific concepts and even clear up misconceptions that may arise from indigenous knowledge. There is a need to continue with the call for a sincere attempt to find a place for indigenous knowledge systems in our school curricula that will recognise and protect its values and contribution to the society. The focus should be shifted towards what makes an effective indigenous knowledge learner and teacher of science, the primary issues indigenous students face will be eliminated by preventing indigenous knowledge loss and protecting indigenous knowledge (Quigley, 2009).

Quigley (2009) argues that by creating a place in science curricula and classrooms for indigenous knowledge, will add to scientific knowledge and methods by learning from indigenous people. Not only would these indigenous learners be empowered, but this could also serve as a model for cross-cultural classrooms that are forced to face similar issues due to globalisation (ibid).

2.5.6 Challenges on the inclusion of IK in Science learning

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). The integration of IK and science in the classroom is not without challenges. Sheya (2014) in his review of the science curriculum documents revealed that IK is not only ignored and underutilised in schools, but also systematically undermined as a potential source of knowledge for development and that the curriculum continues to reinforce western values at the expense of IK. Mukwambo, et al. (2014) argue that we need to be mindful that IK is not a bag of knowledge waiting to be tapped into and dispensed. Instead, we need to critically analyse IK before it can be used, to expose any ambiguities that might come with it, or be caused by it (p. 6). Horsthemke and Schäfer (2007) supports the view of Mukwambo, et al. (2014), but disagree with Mapara (2019) in a study, that mathematics or science concepts may be African or European but cannot be culturally bounded.

In Namibia with its rich diversity of language and culture, curriculum developers will need to be selective about which IK will be relevant to incorporate in the science curriculum. According to Mukwambo, et al. (2014), most science concepts are not yet developed into indigenous language

science concepts. Thus, the curriculum influences teachers and they do not see the need of incorporating IK into school science as it might be time consuming. Lending support to Horsthemke and Schäfer (2007) is Hodson (2009) who states that "every culture has an amassed store of knowledge about the natural environment in which it is located; these bodies of knowledge should be recognised as alternative sciences arising in different sociocultural and physical from those of Western science" (p. 116). He further states that not anything should be included in the curriculum under the banner of science.

In the Namibian context, baggage from the seclusion policies of Namibia's past education period may pose as challenges to the appreciation of indigenous knowledge as it may be incorrectly perceived as intended to keep Black people in inferior positions. Differences in the language of modern science and that of IK also present challenges which are further complicated by little representation of indigenous voice among curriculum decision makers (Reis & Ng-A-Fook, 2010). In support of this view is (Kocakulah, Ustunluoglu & Kocakulah, 2005, p. 3) who state that "cognitive academic language proficiency (CALP) is needed to read textbooks, participate in dialogue and debate to develop the language proficiency needed for success and achievement in school".

For many Namibian learners, English is their third language and they may be experiencing reasoning capacity reduction. This indicates that learners who are struggling to learn science and science concepts in a foreign language lose at least twenty percent of their capacity to reason and understand in the process (Kocakulah, Ustunluoglu & Kocakulah, 2005). Research found that learners who study science in their mother tongue did well in compared to those who learned it through a foreign language (Kocakulah, et al., 2005). This will be a challenge as we have multicultural classes in Namibia. However, the (MoE, 2009) subject policy guides expect teachers to teach in English across the curriculum. In other words, all academic subjects are taught in English, therefore teachers should make a strenuous effort to help learners develop their reading, writing and spelling skills in that language.

Textbooks are also a challenge to teachers and a deterrent to successful integration of IK because they document facts and truth. Teachers rely on documented information and accept it as authentic

knowledge (Shizha, 2007). He further concluded that problems for effectively incorporating indigenous knowledge in science teaching was rooted in the attitudes of teachers, institutional demands, aims of education as perceived by educational administrators, teachers, learners, and parents (p. 316). Since IK is not documented and tested to be proven as valid, it is difficult for the teachers to include it into their lessons because they are not that knowledgeable about IK.

2.6 Theoretical Frameworks

As this study sought to understand how teachers mediate the learning of water conservation through the inclusion of indigenous knowledge, it seems that a socio-cultural perspective and pedagogical content knowledge (PCK) would be especially appropriate and relevant as a theoretical frameworks in this study. The social-cultural perspective encapsulates culture and beliefs in learning. Culture and beliefs influence the way learners learn as illustrated by Vygotsky (1978). I now discuss each of these below.

2.6.1 Socio-cultural theory

The key theme of Vygotsky's (1978) socio-cultural theory is that social interactions play a fundamental role in the development of cognition (p. 1); and also on how cultural beliefs and attitudes impact on how instruction and learning takes place (Cherry, 2013). Lemke (2001) took Vygotsky's work further and explained that the socio-cultural theory stresses that all human activity functions mostly on upbringing, the community they live in, religion, culture and so on. According to him, socio-cultural implies concepts of thinking about science or doing science as a human activity that is carried out within the instructional and cultural context.

Within the socio–cultural perspective, I also drew on Vygotsky's (1978) notion of More Knowledgeable Others (MKO) as a critical tool. From this perspective, it is believed that teachers have more knowledge on the topic water conservation and IK, which they are ideally supposed to transfer to their learners. To give credibility to the latter, it is argued that the role of the teacher in a sociocultural context is to acquaint learners with, and support the use of, new knowledge on the social plane of the classroom in a way that scientific knowledge befits the shared knowledge of the classroom (Leach & Scott, 2003). Furthermore, Hodson and Hodson (1998) point out that the central role of the teacher is to guide learners to new levels of conceptual understanding by interacting with and talking to them. It is within this theory that I will construct the mediation of

learning and the Zone of Proximal Development (ZPD).

2.6.1.1 Mediation of learning

Vygotsky's (1978) socio-cultural theory of human learning describes learning as a social process and the origination of human intelligence in society or culture. The major theme of Vygotsky's theoretical framework is that social interactions play a fundamental role in the development of cognition (ibid, p. 57). Lemke's (2001) study on socio-cultural perspectives on science education supports Vygotsky's theory by stating that we should view "science, science education, and research on science education as human social activities conducted within institutional and cultural frameworks" (p. 296). This gives substantial theoretical weight to the role of social interaction: seeing it, as in the Vygotskyan tradition (Cole, 1996; Leontiev, 1978; Vygotsky, 1963), to be central and necessary to learning and not merely in an ancillary role.

According to Presseisen and Kozulin (1992), mediation of learning is the link between the teacher and learner which leads in part to the achievement of knowledge and skills in science. In their paper they discussed social mediation as being about involving another person in purposefully intervening in the learning process. They elucidated that in Vygotsky's mediation process, a teacher mediates meaning by acting as a medium of symbolic mediation.

Lemke (1990) raises the importance of 'learner talk' and urges teachers to use teaching approaches that inspire learners to ask questions, instead of teachers asking the questions and learners merely responding. Informal small-group discussions, especially in the laboratory, may also give learners an opportunity to talk science without being pressured to do so in a formal classroom situation (ibid.). Thus, for language to become part of the wider community, it must be used in the right way to enhance teaching and learning science concepts in the classroom. Therefore, blending the socio-cultural theory with the knowledge integration perspective through language, which is a view of how people learn (Linn, 1995), should prove to be a powerful tool for this study. Knowledge integration has been successfully used in analysing and describing learners' learning of science (Davis & Petish, 2001). Woolfolk (1998) is of the idea that, Vygotsky's works entails that learners should be given opportunities for co-operative learning and be encouraged to use language to organise their thinking. In sustenance of Vygotsky's ideas, Monteith (2007) discussed ZPD as the

cognitive changes that occur in the ZPD as teachers and learners share cultural tools, for example, language. The next theoretical framework which informed my study was the zone of proximal development which I discuss below.

2.6.1.2 Zone of Proximal Development

In elaborating an appropriate pedagogy for his theory, Vygotsky developed his well-known zone of proximal development (ZPD) model of a classroom as a social unit where a teacher or more experienced peer is able to provide the learner with 'scaffolding' (Wood, Bruner & Ross, 1976, p. 9) to support the student's evolving understanding of knowledge domains or development of complex skills in learners.

As many researchers are not clear on the ZPD, I agree with Stott's (2016) adaptation of Del Rio and Alvarez model of the ZPD. Stott (2016, p. 29) argued that current researchers "stresses the importance of viewing the ZDP in the broader context of Vygotsky's development theory". I totally agree with Stott (2016), when she adapted Del Rio and Alvarez (2007, p. 281) model as it gives a better understanding of Vygotsky's ZDP and clearly states what has been learned in the ZPD by learners and teachers. See Stott's elements of the organising framework in Figure 2.7 below.

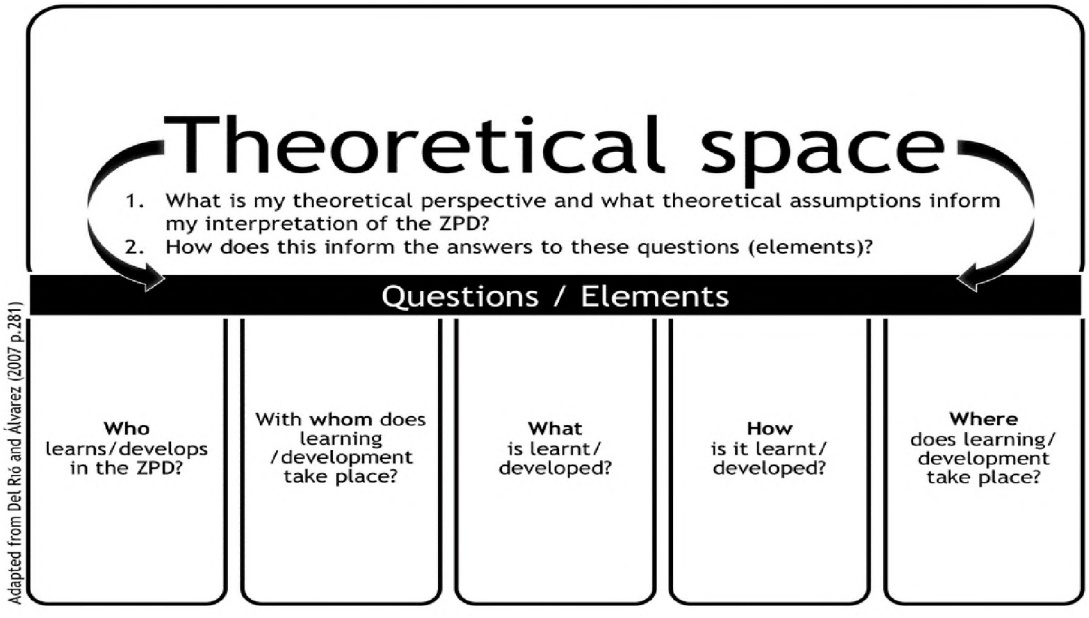


Figure 2.7.1 Adapted from Stott (2016, p. 30)

I have used two of Stott's adapted elements to explain who learns or develops in the ZPD and with what or how is it learned (see Section 5.1.3).

As the inclusion of indigenous knowledge into the topic water conservation is introduced, the teacher, as the more knowledgeable person, can assist the learners to understand and integrate the new concepts obtained from the Topnaar community members faster and better using IK as a mediating tool. This means that teachers need adequate lesson planning and preparation to mediate the ZPD (Stott, 2016; Vygotsky, 1978) in teaching the topic water conservation with the inclusion of IK. Teachers should therefore determine the ZPD of individual learners in order to challenge them to new levels with tasks beyond their actual level of development, and assist them in such a way that they will be able to reach that new level. As language plays an essential role in constructing knowledge in socio cultural perspective, it is placed at the central position of knowledge construction and acquisition (John-Steiner & Mahn, 1996).

Learners construct knowledge in the language that is known to them and this language is embedded in the society from which the learner comes. Teachers must therefore use language as a tool to connect the IK of learners and the western science. Not all western science is in our indigenous languages. Teachers therefore have to find the way to scaffold the language of learners to meet the western language in science by closing the gap between indigenous science and western science. That is, teachers need to develop effective pedagogical content knowledge (PCK) as proposed by Shulman (1986).

2.6.2 Pedagogical Content Knowledge (PCK)

I have observed the role which IK plays, its characteristics, and what it can do. I recognized that it could be used as a vehicle to enhance pedagogical content knowledge (PCK) in our schools. According to Shulman (1987), PCK is:

> The blending of content and pedagogy into an understanding of how particular topics, problems, or issues are organized, represented, and adapted to the diverse interests and abilities of learners, and presented for instruction (p. 8).

The above statement claims that central to PCK is the identification of learners' learning

difficulties. It stresses that in order to deliver meaningful teaching and promote the learning of new concepts, teachers should know how to arrange components of the subject content for better teaching and learning. In my opinion, teachers should develop, use or adapt certain teaching procedures and approaches to fit the teaching of a particular content, in this case study, the inclusion of IK, which fits the learners' learning difficulties best. This includes the use of prior knowledge and experiences that learners bring to the classroom from their social contexts. As science is full of abstract concepts, teachers' pedagogical content knowledge (PCK) is of utmost importance when introducing the topic water conservation, especially indigenous knowledge or local knowledge as many teachers are not familiar with this concept. Shulman (1986, p. 8) claims that teachers have three kinds of knowledge, and that one piece of that knowledge varied from subject area to subject area.

Firstly, teachers need general pedagogical knowledge (PK). Van Driel, Verloop and de Vos (1998) refer to this knowledge as the broad principles and strategies of classroom management and organization that appear to transcend subject matter and is considered the most appealing manner in which teachers organize and present subject matter by telling, explaining, guiding, illustrating, demonstrating, and using texts, computers, media, or workbooks to repackage subject matter into a form that is accessible to the learners. This suggests that every teacher of any subject area needs that same basic kind of knowledge. Secondly, van Driel, et al. (1998) state that every teacher also needs content knowledge. The content knowledge (CK) is the substance (subject matter) of what the teacher will teach.

Thirdly, teachers need pedagogical content knowledge (PCK). This is the knowledge of how to facilitate the learning of the subject the teacher will be teaching to learners in a variety of classroom contexts. Shulman (1986, p. 9) describes PCK as a "particular form of content knowledge that embodies the aspects of content most relevant to a teacher's ability and that comprises the ways of representing and formulating the subject that make it comprehensible to others".

The PCK concept helped me to analyse the teachers' selection of teaching ideas in mediating the learning of water conservation using indigenous or local knowledge during their lessons. Teaching involves different skills and knowledge that teachers have to develop continuously. The concept

of PCK in itself entails key elements that an effective teacher should possess. Moreover, teachers should regard themselves as learners in terms of identifying the weaknesses in their knowledge and the constant integration of new ideas; in this case indigenous or local knowledge to make teaching of topics interesting and relevant. Rennie (2011, p. 23) reasons that "helping learners to learn about and use science in everyday context requires a high level of pedagogical content knowledge". In support of his argument, Rennie (2011) elucidates that using knowledge in different contexts often requires considerable reworking of it so that the knowledge can be used in new situations. In other words, teachers should be able to adjust the content to fit learners' contexts and this is a huge task for some science teachers.

The best way to see how the two theories complement each other is to make use of an analytical tool during my observation of lessons (see Appendix 4).

2.7 Concluding remarks

In this chapter, I discussed relevant literature that support my research. Firstly, I discussed learner-centred education in Namibian context. Furthermore, I discussed the conceptual framework informing my study, namely, the integration of local indigenous knowledge in the teaching water conservation. The conceptual framework included the role of prior knowledge in the learning of science, indigenous knowledge definitions, teachers' knowledge about indigenous knowledge, and indigenous knowledge in relation to science, examples of how indigenous knowledge was successfully incorporated in the teaching and learning of science in Namibia and challenges on the inclusion of indigenous knowledge in the teaching and learning of science. Lastly, I discussed the theoretical frameworks which are Vygotsky's (1978) socio-cultural theory as well as Shulman's (1986) Pedagogical Content Knowledge (PCK).

In the next chapter, I discuss the methodological framework used in my research.

CHAPTER 3: RESEARCH METHODOLOGY

> *A qualitative design is emergent, the researcher usually does not know ahead of time every person that might be interviewed, all the questions that might be asked, or where to look next unless data are analysed as they are being collected...the process of data generation and analysis is recursive and dynamic (Merriam, 2009, p. 169).*

3.1 Introduction

In this chapter I describe the methodological frameworks that underpin my research process in this study. I discuss the interpretive research paradigm which informed my study and describe a qualitative case study in more detail as the research approach for my research. I discuss the techniques for data gathering methods that I used to collect data to answer the questions of my research as well as my role as the researcher. This chapter focuses on two methods of data gathering techniques, namely, a semi-structured interviews and classroom observations to enrich the data gathered. I also inform the reader where the research was carried out in Namibia. The sampling strategies, data analysis, validity and trustworthiness, and ethical consideration are provided in this chapter.

3.2 Research paradigm

Paradigms have to do with the way people sense, look at things to study and know them so that they can make conclusion or recommendations based on their findings. Punch (2011, p. 63) defines a research paradigm as a "[…] basic plan for a piece of research and includes four main ideas […] the strategy, the conceptual framework, the question of what will be studied and the tools and procedures for collecting and analysing empirical materials." It is evident from this definition that a research paradigm is a detailed plan of how the researcher is going to conduct his research.

3.2.1 Interpretive paradigm

This study is situated within the interpretive paradigm. Cohen, Manion and Morrison (2011, p. 17) state that the context of the interpretive paradigm is to understand the subjective world of human experience, to retain the integrity of the phenomena being investigated and efforts made to get inside the person and to understand them within. According to Bertram and Christiansen (2015, p. 26), "within the interpretive paradigm, researchers do not aim to predict what people will do, but rather describe and understand how people make sense of their worlds and how they make meaning

of their particular actions". This approach enabled me and the two Natural Science teachers to seek answers both within and beyond the classroom on how to mediate the topic water conservation with the inclusion of local knowledge using interviews, observations and data analysis. A qualitative case study approach was employed within the interpretive paradigm.

3.2.2 Case Study Method

Patton (2002) observes that case studies become particularly important where one needs to appreciate a particular group of people, particular problems, or distinctive situations in great complexity, and bring out the question of context and history of the topic under investigation. Lending support, Rule and John (2011) posit that a case study is a systematic and in-depth study of one particular case in its context where the case can be a person, a group of people, a school a community or organisation. It is crucial therefore that data generated are well analyzed, discussed and interpreted for better understanding, as persuasively expressed by Merriam (2009) in the epigraph at the beginning of the chapter. I decided to include a limited intervention as part of my study in order to offer support to teachers, hoping it would help them improve their practice. This was clarified during feedback sessions to the teachers concerned. Cohen, Manion and Morrison (2007) further emphasise that the data sets generated should include the meanings and purposes of those people who are their source.

My study focused specifically on identifying indigenous knowledge at Utuseb, a rural settlement 100 kilometres from Walvis Bay in the Erongo region of Namibia, where the Topnaars have been living for generations. This was followed by the design of lessons that include some elements of indigenous knowledge on water conservation and the teaching of these lessons to see their efficacy. These lessons were developed in collaboration with the two Natural Science teachers. My study could thus be characterised as being classroom-based with some element of community-based investigation where the teachers and I had to find local knowledge regarding water conservation. The study could serve to inform IK-science integration at classroom level on how to mediate the topic water conservation with the inclusion of IK. This resonates with Klein's (2011) research on the Nama people in the south of Namibia which concluded that it is possible to collaboratively work with community members to integrate indigenous knowledge in the schools by drawing on their skills and knowledge. As part of my research process, I explored a cultural practice as a case

in order to advance and develop a teaching method for augmenting conceptual development and understanding of it.

In this study, I thus worked closely with the two Natural Science teachers and community members who were my participants and my unit of analysis was meaning-making and the learning that took place. By involving the teachers and community members for information, I hoped that this would give them an opportunity to have and feel a sense of ownership in the study.

3.3 Research Goal and Questions

The main goal of my study was to explore the possibility of integrating local indigenous knowledge in the teaching of the topic water conservation by senior primary school Natural Science teachers. The objectives of this study were:

- To identify, in collaboration with two teachers, some of the local indigenous knowledge about water conservation possessed by members of Topnaar community;
- To explore ways of integrating the local indigenous knowledge into the teaching of the topic of water conservation in Grade 6; and
- To collaboratively identify factors that enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge.

To achieve the goal and the objectives of my study the following questions guided my study.

3.3.1 Main Research Question

How can two Grade 6 Namibian Natural Science teachers use local indigenous knowledge to mediate learning of the topic water conservation?

3.3.2 Sub-questions

1. What local indigenous knowledge on water conservation is found in the Namibian Topnaar community?

   [To answer this sub-question I interviewed people from the Topnaar community which predominantly speaks Nama and Afrikaans. Together with the two teachers we also observed local practices on water conservation in the Topnaar community].

2. How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water?

3. What factors enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge?

[To answer these two sub-questions, I worked collaboratively with the two Natural Science teachers in planning model lessons, had group discussions and used stimulated recall interviews (SRI) to surface factors that enable or constrain the mediating of the topic water conservation using local knowledge. I also observed, video recorded lessons and interviewed teachers].

3.4 Research site and participants

The study was carried out in Erongo Region of Namibia specifically in the Walvis Bay education circuit. Walvis Bay Circuit has seven Primary Schools, two Secondary Schools and five Combined Schools. This research study focused on two school teachers teaching Grade 6 Natural Science in the circuit. I used two teachers from two different schools in Walvis Bay. I thus used the purposive sampling strategy as proposed by Cohen, et al. (2011), who assert that comprehensive information can be obtained from those who possess it.

The criteria I used to choose the participants were that the participant must have taught Natural Science for at least two years in Erongo Region. She/he must be free to disclose all the information about the inclusion of IK in teaching water conservation (interview). They do not need to be knowledgeable about IK, or how it can be incorporated in the science lessons, and this would be determined after the interviews with the Topnaar community members and planning of our lessons. Gender balance was also considered regarding the selection of the participants to have views from both genders about their experiences and perceptions. As a result, one teacher was a male and the other a female.

One teacher was from a semi-private school and one from a public school. I also made use of convenience sampling because the teachers I selected were easily available and accessible (Creswell, 2012). The reason for choosing two different schools was to see how the teachers and

learners approached the topic of water conservation with the inclusion of local knowledge as one school is private and situated in the centre of town (urban) and one in the township (rural).

My other research site was in the Utuseb settlement along the Kuiseb River with the local people as participants to tap into their local knowledge on how to conserve water. The lower Kuiseb Valley also is the home of the small Topnaar or #Aonin community, a Nama tribe and one of the oldest indigenous people of Namibia. Living in the Namib Desert for at least some 8 000 years with the modest !Nara plant as their main source of nourishment (Dentlinger 1983, p. 3).

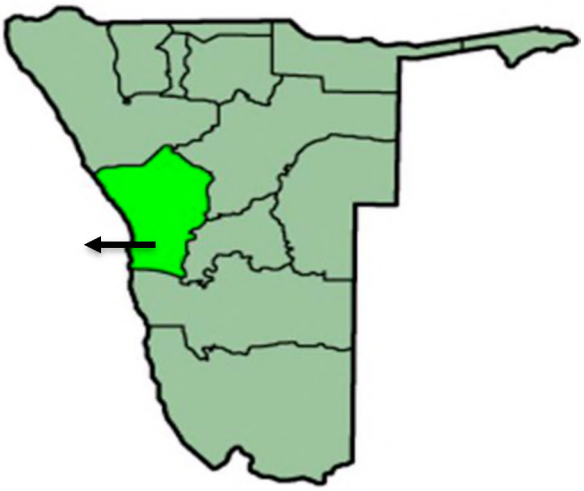


Figure 3.4 (a) Erongo Region https://sites.google.com.site.nam 16goba

Figure 3.4 (b) Showing the Namib Desert

Figure 3.4 (c) Showing Topnaar location along Kuiseb River **bed**

https://sites.google.com.site.nam 16goba

3.5 Researcher

My role as a researcher in this study was to facilitate the research process. During the interview, for instance, I sampled the two teachers for the semi-structured interviews with the Topnaar community members. Furthermore, I observed the two teachers teaching water conservation using the IK we had obtained from the Topnaar community members. This helped me to get first-hand information from the lessons. I asked for permission from all the participants before conducting the research.

Finally, during interviews I probed for more information from the participants to supplement the lesson observations. In sustenance of this, Henning, et al. (2007) indicate that in view of the interview the interviewer is a neutral facilitator. Lastly, I transcribed the interviews and observation video responses and then analysed the data, and wrote the thesis by interpreting the data and presenting the findings to make a meaningful contribution to the nation in the field of education.

3.6 Data gathering techniques

I used document analysis (curriculum documents) to contextualize my study (see Section 1.2.1). For my main study, however, I used observations and semi-structured interviews as outlined in the table below. I now discuss each of these in detail below.

Table 3.6: Data gathering techniques

Stages	Method used to gather data	Data to be gathered	Purpose	Research Sub-Questions
Stage 1	Document analysis: Curriculum documents	1. National Curriculum 2. Science Curriculum 3. Syllabi: (a) NSHE Syllabus Gr 5-7: Content to be covered on topic of Water Conservation in Gr6. Gr 6 Natural Science textbook Workbooks of learners and lesson plans of teachers. SATs – Grade 7	To get insight into what the National and Science curriculum say about Conservation, Sustainable Development and Indigenous Knowledge. To find out information about the content to be covered on the topic Water Conservation in Gr 6. To investigate how much assistance teachers get from textbooks in the mediation of the topic. To gain insight into how teachers support learners in the mediation of learning. To gain insight into the performance of Gr 7 learners in application questions, especially relating to water conservation.	Data from documents were used to strengthen my context in this thesis (see Section 2.2).
Stage 2	Semi-structured interviews with: Topnaar community members and two Gr 6 Natural Science teachers after the observed lessons.	The teachers' perceptions and experiences with the lessons. Have you ever used IK/local knowledge in your teaching? What are your views on the inclusion of IK during NSHE lessons in Grade 6? What factors do you think influence your views on the inclusion of IK during NSHE lessons in Grade 6? What could be the reason why Grade 6 NSHE teachers do not integrate IK in their lessons? What benefits could there be for including IK into NSHE lessons?	To gain insight into the strategies of teachers in supporting learners. To get clarity on challenges experienced in teaching the topic. To gain insight into possibilities of intervention to improve the mediation of learning. To get insight into their understanding of water conservation with the IK they possess.	Research sub-question 1 To answer sub question 1, we interviewed people from the Topnaar community with the help of a Topnaar expert.

Stage 3	Co-develop model lesson plans. Lesson observations of Gr 6 science lesson introducing the topic of water conservation using IK.	How teachers mediate learning of the topic water conservation	To gain insight into the strategies of teachers in supporting learners. To gain insight into possibilities of intervention to improve the mediation of learning.	Research sub-questions 2 and 3. To answer these sub-questions, I observed, video tape lessons and interviewed teachers.

3.6.1 Document analysis

According to Cohen, et al. (2011), documents once located and examined do not speak for themselves but require careful analysis and interpretation. Furthermore, documents such as textbooks and educational policies can be examined to obtain useful information. I thus made use of official documents such as the NCBE (2010) and the Natural Science and Health Education Syllabus Grade 5-7 (2015).

Additionally, the standardized Achievement Test (SAT) results for Grade 7 science (Shaakumeni, 2012) and the examiners' reports were analysed to get some insights on the performance of learners in the application questions, especially the topic of water conservation. The Standardised achievement tests report as well as official documents were discussed in detail in Chapter 1 to strengthen my context.

3.6.2 Interviews

According to Cohen, et al. (2007, p. 349), "the interview can press not only for complete answers but also for responses about complex and deep issues". Interviews are therefore suitable for use with both educated (literate) and uneducated (illiterate) people.

3.6.2.1 Semi-structured interviews

Interviews have long been the most popular method in qualitative research and case studies (Rule & John, 2011). Ary, Jacobs, Razavieh and Sorensen (2009) state that interviews are used to gather data from people about opinions, beliefs, and feelings about situations in their own words. They

are used to help understand the experiences people have and the meaning they make of them rather than to test hypotheses. I conducted semi-structured interviews (see Appendix 2b) with two selected Grade 6 Natural Science teachers and Topnaar members in the following way.

Teachers:

- Their views and experiences in teaching the topic on water conservation with the inclusion of IK and the examples they have used after observed lessons.

Topnaar members:

- Interviews (Topnaar expert and me) and Topnaar members on their water practices.

Ary, et al. (2009) further posit that in the semi-structured interview, the area of interest is chosen, questions are formulated but the interviewer may modify the format or questions during the interview process and that the questions are typically open ended and designed to reveal what is important to understand about the phenomenon under study. The information gathered through the interviews guided me in the implementation of my main research question.

I developed an interview schedule (questions) to guide the interview (see Appendices 2a and 2b) with two participating teachers and Topnaar community members. During each interview, probing was done when the participant did not answer the question or a key opinion was raised that needed further clarification. The interviews with teachers were conducted in the afternoons so that I would not interfere with their school activities. The interviews with the Topnaars were conducted during the week as it was the only time the expert was available. I can conclude that both teachers and Topnaar community members were happy to be part of the study and responded positively to the questions asked. The Topnaar members were happy that interest was shown in their water practices. The duration of the interviews varied from 25 to 35 minutes, depending on how the participants responded.

The interview has certain limitations, however, as Bell (1999:91) identifies it as "a highly subjective technique and therefore there is a danger of bias". Despite this shortcoming, I found the use of interviews to be valuable, because they allowed the respondents to have the freedom to

engage in rich conversation through which they could easily explore their thoughts without fear of being limited by closed questions.

3.6.2.2 Stimulated recall interviews

Lyle (2003, p. 861) defines stimulated recall interview (SRI) as an "introspection procedure in which (normally) videotaped passages of behaviour is replayed to individuals to stimulate recall of their concurrent cognitive activity". The central idea of using an SRI was to discover the exercise used to generate the subject's thinking during the period being replayed.

SRI was performed with my participating teachers while watching the videotaped lessons. That is, after the observation process I went back to teachers to watch the recorded videos with them. I used member checking by giving the transcripts back to my participants. They watched the videos while holding the transcripts to see where I had recorded incorrect information and made the changes. Herein lies the importance of validation of data (see Section 3.9).

The teachers were especially happy to see themselves teaching and for the first time they had a glimpse of how they can make mistakes. Repeating of certain words "ok", not getting to a learner's name or not having eye contact was what they could immediately recall. The SRI lasted for about 30 to 45 minutes and were done after school.

3.7 Joint design of lessons and observation of taught lessons

Hatch (2002) states that observations are used to understand a situation from the perspective of the participants. Cohen, et al. (2011) concur and further suggest that a distinctive feature of observation as a research process is that it offers the investigator an opportunity to gather 'live' data. All the lessons on the topic conservation for each teacher were video recorded by me. This enabled me to gather data on all aspects of the mediation of learning of the topic. I also observed community members as they explained their perspectives on water conservation to me (see Appendix 4) for the lesson observation schedule.

3.8 Data analysis

Cohen, et al. (2011, p. 537) state that data analysis involves "organising, accounting for and

explaining the data; in short making sense of data in terms of the participants' definitions of the situation, noting patterns, themes, categories and regularities". In qualitative research, findings are typically expressed by quoting interviews or relating experiences the researcher has had in the field (Jackson, 1995).

Interviews with the teachers were conducted in English. The interview question of the Topnaars were translated by the expert into Nama. They were then transcribed and the transcriptions were interspersed with the corresponding field notes. For the interviews with the Topnaars, colour coding was used to identify the themes. Most often, I have used direct quotations from the participants to enable their ideas to come through in the study. I was able to generate analytical themes which, according to Bassey (1999), are based on raw data but speak directly to the research questions.

Data generated through video recorded lessons, were inductively analysed by transcribing the videos and audio-taped interactions with teachers with a view to establishing analytic statements (categories/themes) regarding teachers' pedagogical practices when dealing with subject content and indigenous knowledge obtained from the Topnaar community. According to White (2005, p. 186), the following comprise the cyclical process of data analysis:

- Becoming familiar with the data and identifying main themes in it (reading);
- Examining the data in-depth to provide a detailed description of the setting, participants (teachers and community members) and activities (describing);
- Categorising and coding pieces of data and physically grouping them into themes (classifying); and
- Interpreting and synthesising the organized data into a general conclusion or understanding (interpreting).

During this cyclical process, the generated data sets were used to identify themes related to teachers' interpretation with regard to the use of indigenous knowledge (IK) to mediate learning during the lessons, and the possible influence of the two teachers' Natural Science content knowledge on understanding the topic water conservation, using IK in particular. To this end, I modified the observation protocol tool indicator of Weiss, Pasley, Smith, Banilower and Heck

(2003) to observe the extent to which the content of lessons reflects the use of IK as well as the teachers' and learners' understanding of IK (Appendix 4).

3.9 Validity and trustworthiness

Cohen, et al. (2011, p. 195) define triangulation as "the use of two or more methods of data collection in the study of some form of human behaviour". Triangulation thus helps researchers to detect errors made in the analysis of the data gathered and strengthen the validity of the findings. Although there are different kinds of triangulation methods, I made use of the observation (of lesson presentations), interviews and document analysis in this study. Watching the video recorded lessons with the teachers and giving interview transcripts back to the teachers formed part of validation of what happened in the class. Member checking was done through the Topnaar expert reading the interview transcripts to the Topnaar participants to ensure information was transcribed correctly.

The transcripts were in English, but he read them in Nama. They were satisfied that their information was written correctly as they had expressed themselves. This is in line with the Afrocentric perspective which, according to Van Wyk (2015, p. 5), creates an avenue through which human and social scientists can systematically place African phenomena at the centre of analysis and synthesis in the research. This concurs with earlier work by Mkabela (2005), which indicates that an Afrocentric researcher seeks to make a cross-cultural study which is directed at specific issues. In this case study, the IK possessed by the Topnaar community in conserving water which has a potential of new knowledge being created.

Prolonged engagement and persistent observation ensured credibility and trustworthiness in this study. This was done by co-developed lessons, a workshop, SRI with teachers and giving back interview transcripts. The same was done with the Topnaars when giving back their transcripts to ensure the correct information would be processed. Stott (2014) offers that peer probing provides a rational, external evaluation of the research process. My supervisors played this role throughout the course of this study which involved posing questions about the procedures, meanings, interpretation and conclusion of the research.

3.10 Ethical considerations

Cohen, Manion and Morrison (2007) argue that an ethical issue is that which requires researchers to strike a balance between the demands placed on them as professional scientists in pursuit of 'truth' and the subjects' right and values potentially threatened by the research. Thus, prior to the research I sought permission from the Education Department of Erongo region (see Appendix 1a) as well as school principals from the identified schools and participating teachers (see Appendices 1c & 1d). Permission was also sought from parents whose children formed part of the research (see Appendix 1e). I also informed the headman of the Topnaars to ask permission to interview local people at Utuseb as well as the community members (see Appendix 1b).

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. The agreement forms assured the participants that their names would be protected by the use of pseudonyms. Participants were informed that participation in the study was voluntary and withdrawal at any point would be allowed. I must highlight that the photographs of participants in chapter 4 and 5 were used with their permission.

3.10.1 Respect and dignity

I wrote letters to the Regional Director of Erongo Region, Inspector of Education and the principals of the schools involved in this research. The letters spelt out clearly the purpose of the study. Meetings were also held with the respective principals to discuss the contents of the letters and agreed on dates for data collection. Letters were also written to the parents of learners who were involved in the research as well as the Chief of the Topnaar community. Before the letters were taken to parents, I explained the contents of the letter to the learners. In all cases I made it clear that some lessons would be recorded. All participants were assured that the videos would not be made public and should the need to share them with a third party other than Rhodes University lecturers, their consent would be requested in this regard.

3.10.2 Transparency and honesty

I received informed consent from all my participants after explaining what I intended to do in the

study. At every stage of the data gathering and analysis process findings were shared with the participants.

3.10.3 Accountability and responsibility

Since some of learners who participated in my study were below the age of 18, informed consent had to be given by their parents (see Appendix 1e). The two teachers, the expert and Topnaar community members also signed their consent forms (see Appendix 1d).

3.10.4 Integrity and academic professionalism

During this study, I kept a research journal in which I recorded all the details of the process and pieces of data. Every time I met with any of my participants I made a note of what was discussed and any other relevant information. A file for hard copies of documents was also opened. For example, all the original letters from the Director, Inspector and principals were documented and filed. Lessons were videotaped and saved on discs on my computer. Analysis of videos was done with the assistance of the participants

3.11 Limitations of my study

As this is a case study of two schools and two teachers in the Walvis Bay circuit, the results of this study cannot be generalised. However, it is anticipated that the study may provide some insights into how two Grade 6 Natural Science teachers in these specific schools mediate the learning of the topic on water conservation through the inclusion of indigenous knowledge with a view to enhancing sustainable development.

One must also take into consideration that the results of the study can be affected by the presence of the video camera and me as an observer which might change the normal behaviour of teachers and learners as they interact in the classrooms. One of my participants became ill, which caused a delay in collection of my data. Another factor was that on our arrival at Utuseb, many Topnaar community members were not there as they had gone into the desert to collect !Nara fruits. On my first trip to Utuseb we had a tyre burst and, as the spare tyre was not in good condition, we had to turn back.

3.12 Concluding remarks

In this chapter, I described the methodological framework I used to collect data for my research. I also discussed the interpretive paradigm which underpinned this study. The issue of trustworthiness was interpreted by using, triangulation, validity and trustworthiness. Lastly, I looked at ethical considerations that I followed from the start to the end of my research and limitations were summarized.

In the next chapter, I present the data gathered using semi-structured interviews with Topnaars, lesson observations and interviews with teachers.

CHAPTER 4: DATA PRESENTATION, ANALYSIS AND DISCUSSION (PHASE 1)

> *"Ubuntu is an indigenous aphorism that serves as the spiritual foundation of African societies" (Louw, 2004, p. 2).*

4.1 Introduction

The main goal of my study was to explore the possibility of integrating local indigenous knowledge in the teaching of the topic on water conservation by senior primary school Natural Science teachers. To achieve this goal the following questions guided the study:

- What local indigenous knowledge on water conservation is found in the Namibian Topnaar community?
- How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water?
- What factors enable or constrain Grade 6 Natural Science teachers in mediating the learning of the topic water conservation using local indigenous knowledge?

This chapter deals with the presentation and interpretation of three sets of data gathered during Phase 1 of my research. The first stage is the profile and selection of my research participants. The second stage is my visit to and interviews with the Topnaar community participants and the third stage deals with a workshop conducted with the two teachers as well as the co-designing of lessons. The report on findings from data gathered via document analysis have been included in my Chapter One to strengthen my context. I must highlight that the photographs of participants in chapter 4 was used with their permission.

This chapter started by outlining the teachers' profile information, which I consider crucial, so that the data presented is properly contextualized.

4.2 Teachers' Profiles

Two teachers from different schools were involved in this study. Both schools are situated in an urban area in Walvis Bay in Namibia. As explained in Section 3.2, the teachers were 'handpicked', to gain insight on how they make meaning of the topic water conservation by including indigenous knowledge. This helped to start the process of inferring how teachers mediate the learning of the

topic water conservation using local indigenous knowledge about water.

Teacher 1: Male (Lazarus - pseudonym) (T1) is situated at School A, which is a private school with many resources available and with only sixteen to twenty learners per class. The learners as well as the teacher speak Afrikaans as their mother-tongue with English as a second language. Lazarus is Damara/Nama with a Bachelor of Science specialising in Environmental, Molecular and Physiological Biology with two years teaching experience. Currently he is teaching Natural Science and Health Education to Grade 5 and 6 classes. He is confident in using learning and teaching support materials (LTSMs). These include, for example, information technology such as the portable mini projectors, white board and computer. He does not have any educational qualification but, because of his science degree, was given a post at the private school. He has enrolled at the University of Namibia (UNAM) for a post-graduate Diploma in Education.

Teacher 2: Female (Anna - pseudonym) (T2) teaches at School B, a government school with few resources, although a projector and screen are available at the school. Anna is able to use the projector, screen and laptop as it was part of her teacher training. There are up to thirty-five learners per class. Although the learners are all from different cultural groups, they can speak their respective mother tongues (such as Oshiwambo, Otjiherero, Damara/Nama, Silozi) as well as Afrikaans and English as a second language. Anna's mother tongue is Oshivambo, but she speaks English fluently even though it is her second language. She has a four year BEd Honours degree from the University of Namibia, and she specialised in Mathematics and Natural Science. She teaches Natural Science and Health Education to five Grade 6 classes.

4.3 Working with local communities

Fig 4.3 (a): Community participants

The second stage of data gathering was the interviews conducted with the local Topnaar community members to gain some insights into their water practices. Ten community members took part in the interviews. Interviews are a powerful tool for obtaining qualitative research data for, according to McMillan, 2004, they are a "more intrusive form of data collection procedure" that involves "asking participants questions, and recording answers" (p. 2).

In this study, semi-structured interviews with the Topnaar community members were conducted to help answer my first research question:

> What local indigenous knowledge on water conservation is found in the Namibian Topnaar community?

Community members in this study were not 'subjects'. I carried out the study 'with' them and not 'on' them (Reason, 1998). The participants were actively involved in the creation of knowledge (Malcolm, Gopal, Keane, & Kyle, 2009).

My visits to Utuseb were not without the agreement of the traditional leader as I did not want to be seen as being obtrusive (Morgan, 1987). Rural and indigenous communities are structured differently from non-rural ones. There are certain hierarchies that exist in rural communities that do not exist in urban and other non-rural areas. Recognising the position of traditional leadership enhanced the fostering of mutual trust with the rest of the community. In this study, where marginalised groups are used for interviews, trust in relationships is essential to the quality and outcomes of the research (Minkler, 2004). I was honoured to be granted access to conduct my interviews at Utuseb.

Figure 4.3 (b): Permission letter by the Chief (see Appendix 1b)

For the Topnaar people, the natural world is superior, and gives generously to meet human needs. It was common to hear descriptions of both the natural world and that of humans being closely connected. The appropriate human response to nature's frugality is to be respectful and to care for the natural world.

Nature gives, and the people receive. People are secondary in their relationship with, and not dominant, over nature. They are fortunate beneficiaries of nature's kindness; hence they do not necessarily have power to make decisions about whether or how to exploit nature. In none of the participants' responses in the interviews are there any suggestions of an attitude of conquest over nature. What stood out was that water is the most important factor for their existence:

- *Water is important as it makes the trees grow which produce pods for their livestock.*
- *Water is important for the growth of the !Nara, which is a rich source of food and water for humans and animals. Even the root of the !Nara is a source of water for people and has great medicinal value.*
- *Water is not for oneself but for the next person.*

Fig 4.3 (c) Trees produce pods

Fig 4.3 (d) Pods are fed to the goats

Fig 4.3 (e): !Nara plant and products

It is evident in the pictures above that the Topnaar community does not view the world as isolated parts. Their focus on the interrelationships suggests a universal view of nature, where any individual components are seen as fragments of a whole. People are part of this universal picture – "part of a world in which plants, animals and natural features are alive with ancestral and spiritual significance" (Chinn, 2007, p.1250). Studies among indigenous people have pointed to this interconnectedness (Aikenhead & Michell, 2011; Hamminga, 2005; Kawagley, Norris-Tull & Norris-Tull, 1998; Odora-Hoppers, 2005). From my semi-structured interviews with the Topnaar participants, four sub-themes emerged which relate to my research Question One. I summarise the ways in which the Topnaar people understand their relationship with water and the conservation of it in relation to the world in the table below.

The following is a brief description of the codes mentioned in Table 4.3(a)

Code	**Explanation**
RQ	Research Question
TNM	Topnaar Male
TNF	Topnaar Female

Table 4.3 (a): Themes, indicators, and their sources for Research Question 1: RQ1 (see Appendix 2a)

RQ1: What local indigenous knowledge on water conservation is found in the Namibian Topnaar community?		
Sub-themes	**Indicators**	**Evidence (from data source)**
Spirit of *Ubuntu*	*A special marker was placed on top*	TN1M3, TN6M3, TN10F3,

	so others can see it, they did not save water for themselves but they think of the next person	TN9M6 , TN10F6
Connection to Mother Earth	*We are part of nature, as we see ourselves link with everything around us*	TN1M2, TN7F2, TN7F8
Valuing Cultural Identity	*My ancestors, our forefathers, the Topnaars*	TN2M1, TN3F1, TN4M1, TN5M1, TN6M1, TN7F1, TN8F1, TN9M1, TN10M1, TN1M3,TN3F3, TN4M3, TN8F3, TN9M3
Health and Healing	*Its roots contain water which is bitter but I drink it because it is healthy. Its roots contain water and we drink it for high blood pressure*	TN1M7. TN3F7, TN7F7,TN10F7

From the broad categories of data that emerged from the transcripts of the ten Topnaar participants, I proceeded to pull together some of these categories by checking for similarities and contradictions. Four preliminary themes emerged from the grouping. The central theme that emerged from the interviews with the Topnaars was (Ubuntu-relatedness) meaning water was important for their culture's health and well-being, and they need to conserve it as everything relates to Mother Earth.

Table 4.3 (b): Theme and supporting theory/literature

Main Themes	**Supporting theories/Literature**
Spirit of *Ubuntu* Connection to Mother Earth Valuing cultural identity Health and healing	Aikenhead and Michell (2011); Hamminga (2005); Kawagley, Norris-Tull and Norris-Tull (1998); Odora-Hoppers (2005); Le Grange (2012); Vygotsky (1978).

4.3.1 Spirit of *Ubuntu* present in the Topnaars

The principles of *Ubuntu* are part of the daily life of rural communities. These principles include: respect, communalism, interdependence, supportiveness, solidarity, cooperation, caring for others, kindness and neighbourly support (Hamminga, 2005; Malcolm & Alant, 2004; Louw, 2004). Broodryk (2006) states that *Ubuntu* is the basis of the African worldview. Concurring, Le Grange (2012), states that in the Shona language there is a broader concept than *ubuntu*, "ukama which means relatedness – relatedness to the entire cosmos" (p. 332).

This came clearly from statements made by:

> TN1M3: "*Water was put in ostrich egg and stored under trees to keep it cool. A special marker was placed on top so others can see it.*"
> TN6M3: *"My father told me that they did not save water for themselves but they think of the next person."*
> TN10F3: *"Water was stored in ostrich eggs under trees at specific places to provide for*

the next person."

TN9M6: *"I save water because my goats and !Nara melons also need water."*
TN10F6: *"We save water because our goats need also water."*

The statements above clearly shows that *Ubuntu* is supported by a concern for the welfare of others, manifesting through among others, respect, communalism, kindness, generosity, honesty, caring for others, and participation for the common good even the environment (Hamminga, 2005).

4.3.2 Connection to Mother Earth

For the Topnaar people of Utuseb, the natural world is superior, and gives generously to meet human needs. It was common to hear descriptions of both the natural and human worlds as being closely connected. This connection with water was also talked about in the context of the interconnectedness of water with all of the natural world. This means that if their water source comes under threat they will lose their connectedness to their culture, plants and animals. The appropriate human response to nature's providence is to be respectful and to care for the natural world. Participants stressed the importance of water for their connection to Mother Earth. The quotes below highlight the importance of water in the Topnaar community and draws attention to its necessity for the life of plants, animal and humans and the importance of protecting water.

TN1M2: *"Nature provides water and some !Nara melons to harvest."*
TN8F2: *"I harvest !Nara melons which mother earth provides."*
TN1M3: *"We are part of nature. Without water our livestock cannot survive and !Nara will not grow."*
TN7F3: *"They regarded the Topnaar as part of nature. Water was mostly used for human consumption and for livestock. Washing was limited to save water."*
TN6M8: *"They can learn from us as we see ourselves link with everything around us. What we do affects other living things."*

Concerns about losing their connectedness to Mother Earth if their water source comes under threat were raised in the interviews. This means threats to the environment, and water in particular. This is seen in the following statements made by all about who see the extraction of water by the water supply company to fishing industries and mines as a threat to their existence. The name *"NAMWATER Supply Company"* was mentioned by all interviewees as a threat to water resource.

4.3.3 Valuing Cultural Identity

According to Apusigah (2011), an important value of African society is the near insane search for continuity. This means that families, clans and entire people go through elaborate processes,

including rituals, in order to maintain their lineage and continue life. She further states that older generations commit themselves to teaching their traditions and values to the young so they can pass it on to their next generation (p. 9). This concurs with findings that a distinguished characteristic of indigenous knowledge is that it is handed over from one generation to the next (Kibirige & Van Rooyen, 2006; Ocholla & Onyancha, 2005). By virtue of that, indigenous wisdom gives value to cultural identity. This is evident in the way the community members talked about their ancestors, giving a sense of value and cultural identity to them. The following question was raised: What knowledge did the Topnaars use to survive these dry conditions? See the responses below by interviewees.

TN2M1, TN6M1, TN9M3: *"Our forefathers"*
TN3F1, TN41, TN5M1, TN7F1, TN9M1, TN10F1, TN1M3: *"Our Ancestors"*
TN8F1: *"The Topnaars"*

4.3.4 Health and Healing

In the topic water conservation, the exploration of water and health is almost always in the context of access to safe drinking water. This stems from the Topnaars' one-dimensional view of water that conceptualises it only in a physical sense. Meaning, water is not for oneself but for the next person, animal or plant. When water and health are seen through an indigenous lens, the importance of water to health extends much further, as the following quotes demonstrate. Participants talked about a number of ways that water contained in the roots of the !Nara plant plays a role in health and healing. They brought up the use of water in the root of the !Nara as an alternative to cholesterol and high blood pressure medication.

TN1M7: *"Its roots contain water. It is bitter but I drink it because it is healthy".*
TN3F7, TN7F7: *"Its roots contain water, we drink it for its medicinal value"*
TN10F7: *"Its roots contain water and we drink it for high blood pressure and cholesterol"*

To bring all themes together and to better understand the research question, one needs to look at:

How do the Topnaar people view the world?

Snively and Corsiglia (2001) reason that Western modern science is actually a reflection of the Western culture and not the global set of cultures. Snively and Corsiglia (2001) and other post-colonial scientists vied that all other cultures have developed their own ways of understanding the world realisms and independently produced solutions to their own problems using their own understandings as reverberated by Berger and Luckman (1966).

In view of their orientation towards *ubuntu* and respectful relationships with both people and nature, the Topnaar community shows responsibility towards the environment and the health of others. Because of their understanding of nature as being interconnected, they are likely to demonstrate (probably with ease) an understanding of the world as a set of related systems by recognising that they do not exist in isolation. This echoes with Le Grange's (2012) view of *ukama* which means relatedness.

The interviews with the Topnaars were a way of collecting information relevant to the topic water conservation and of finding out which indigenous knowledge was relevant to the workshop and could be included in the science lesson. This corresponded to Hamminga's (2005); Malcolm and Alant's (2004) as well as Louw's (2004) principles of caring for others, kindness and neighbourly support. This view resonates with Le Grange's (2012) principle of relatedness.

In Section (3.6.2), I mentioned I had an informal talk with teachers to find out how they had presented the topic water conservation in the past. This was to give me as the researcher an idea of what to take to the workshop. What transpired was that both teachers strictly followed the prescribed syllabus and little room was left for the inclusion of indigenous knowledge. Information from the textbook related to how water can be conserved. Furthermore, no prior knowledge of learners was taken into consideration during their lessons.

Both teacher's reasons were that they were judged according their examination results. This echoes with Shizha's (2007) views that problems for effectively incorporating indigenous knowledge in science teaching was rooted in the attitudes of teachers, institutional demands, and the aims of education as perceived by educational administrators, teachers, students, and parents (p. 316). Since IK is not documented and tested to be proven as valid, it is difficult for the teachers to include it in their lessons because they are not that knowledgeable about IK.

4.4 The workshop

The workshop was held at a Primary School in Kuisebmund during September 2016. The program of the workshop is reproduced in figure 4.4(b). The purpose of the workshop was to:

a) Introduce different concepts to teachers (e.g., indigenous knowledge, Western science);

b) Provide suggestions through to which an integration of indigenous knowledge and Western science can occur in the classroom with the IK found at the Topnaar community regarding water conservation; and

c) Co-teaching of lessons to include IK in the teaching of the topic water conservation.

The workshop was guided by the following research questions:

- How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water?
- What factors enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge?

The participants were also informed that the pedagogical model of Snively and Corsiglia (2001) would be used as a starting point in the preparation of their lessons. This means the teacher would need to have prior knowledge and understanding of the processes involved in the various activities in the community and their appropriate application to school science. The participants were informed that the models of integration were based on a major feature of constructivism, namely, that the prior knowledge of the learner was important.

Figure 4.4: (a) Introduction of the workshop and its participants

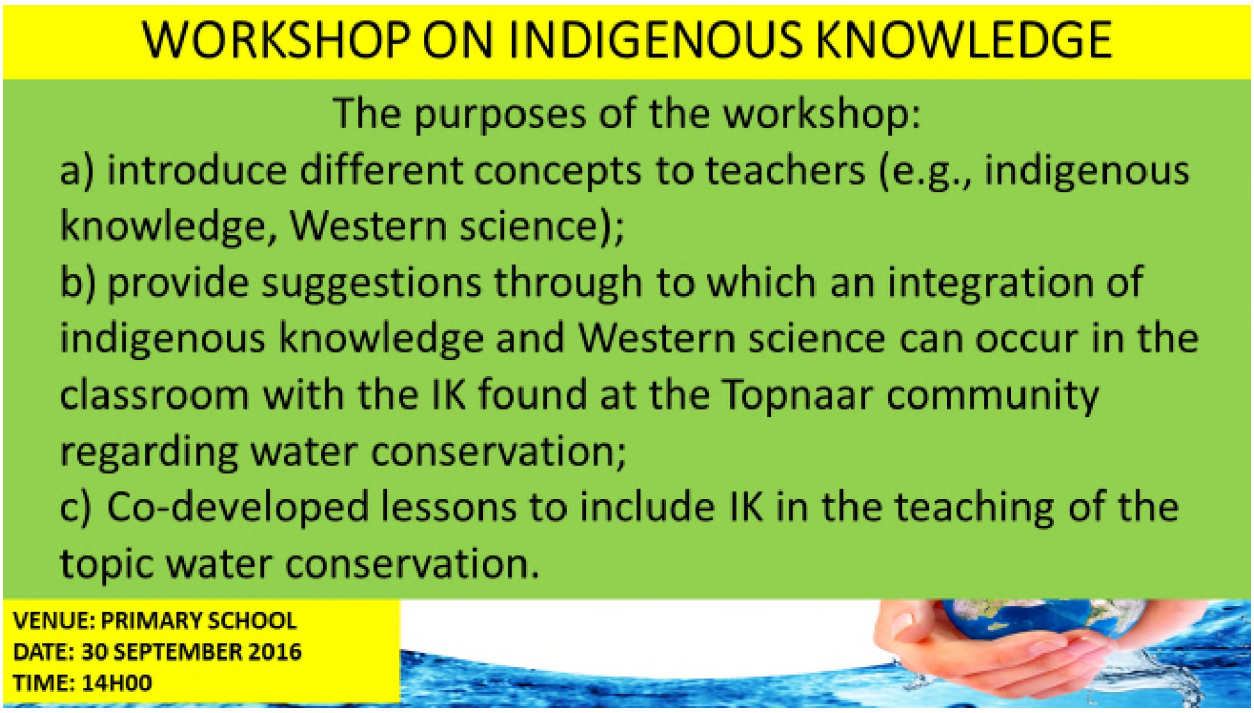


Figure 4.4 (b) Purpose of the workshop

Fig 4.4 (c): Researcher

Fig 4.4 (d): Teacher 1M (T1M) and Teacher 2F (T2F)

The outcome of the workshop was to ensure that Lazarus and Anna were well prepared for their lesson presentation on how to incorporate indigenous knowledge in the teaching of the topic water conservation. This will be discussed in Section 5, Phase 2.

4.4.1 The instructional design of the workshop

The research participants indicated that they had not received training on how to integrate science and indigenous knowledge, and that they did not have sufficient knowledge of indigenous knowledge to teach this aspect confidently to their learners. I chose a workshop as an intervention and continuing professional development of teachers to improve their teaching skills and for developing new methods of teaching. I preferred not to lecture to the teachers on IK but chose the workshop as a means of making the concepts indigenous knowledge and Western knowledge clearer to teachers. In such a workshop the teachers could read and discuss the descriptions of IK and on how to incorporate it in their teaching of the topic water conservation. The lesson content had to address issues relating to water conservation and how to integrate science and indigenous knowledge in the classrooms, with an indigenous content.

4.4.2 Co-teaching of lessons

Co-teaching, also called collaborative teaching or team-teaching, is a method of instruction that brings together two teachers of equal status to create a learning community with shared planning, instruction, and student assessment (Bouck, 2007; Crow & Smith, 2005). For my two research participants, the shared experience of co-teaching sparked conversations that enlightened their personal values and assumptions about teaching and learning that they were unaware of, in this case the introduction of IK to the teaching of the topic water conservation.

There are potential challenges to co-teaching. These include the additional planning time required and difficulties related to any power imbalances between the instructors (Ginther, Phillips, & Grinseki, 2007). This was the case with us as time was of the essence and teachers are not always available because of their responsibilities at their respective schools. However, we rather focused on the benefits the co-teaching of lessons could have for the two research participants: personal development and increased teaching competence and skills especially by incorporating the power point slides as well as the Topnaar community expert.

4.5 Concluding remarks

The focus of this chapter was to present findings relating to the following question:

> What local indigenous knowledge on water conservation is found in the Namibian Topnaar community?

My field experiences revealed that there is more to IK in the Topnaar community at Utuseb than that which can be easily related to school science context. The forms of knowledge at Utuseb are underpinned by a worldview that is different from that of the Western science framework, on which school science is based. The qualitative data from the interviews were analysed and the four sub-themes which emerged from the interview data were: the Spirit of *Ubuntu* that is present in the Topnaar; their connectedness to Mother Earth, valuing cultural identity and health and healing.

The answers to these sub-themes summarise the indigenous knowledge of the Topnaar community. My interaction with the participants in this study showed that their knowledge is characterised by relationships at social and physical levels. Life is therefore understood as being interconnected. Water was talked about in many different contexts throughout the interviews. These quotes demonstrate that water is very important for both health and connection to culture, to identity, the connection to Mother Earth and health. Since water is understood in a very holistic sense; human health and the health of Mother Earth were rarely separated. Concerns about declining water levels which is a thread to their existence and interconnectedness to Mother Earth quality were expressed by all participants.

Chapter 5 Phase 2 presents, analyses and discusses the data generated from lesson observations and interviews with teachers after I observed the lessons.

CHAPTER 5: DATA PRESENTATION, ANALYSIS AND DISCUSSION (PHASE 2)

> *An attempt by the researcher to find meaning in the data to answer the "so what?" question in terms of the implications of the findings and filtering out the undesired data (Gay, Mills & Airasian, 2009, p. 448).*

5.1 Introduction

The previous chapter consisted of the presentation of the data I gathered during this study by means of semi-structured interviews with the Topnaar community members. In this chapter, I present, analyse and discuss the data generated from my lesson observations and interviews with teachers in relation to mediating the topic water conservation with the inclusion of indigenous knowledge. I also linked my discussion to the socio-cultural and pedagogical content knowledge (PCK) theories which underpin this study. This approach corresponds with what Gay, Mills and Airasian (2009) state in the epigraph above. That is, I tried to make sense of the data I gathered using literature, my theoretical lenses and my own experience.

To remind the reader, the main goal of this study was to explore how Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water, using different mediational tools.

Firstly, I present the data generated from the two lessons that I observed to answer my research sub-question 2:

> How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water?

Secondly, I present data from semi-structured and stimulated recall (SRI) interviews with teachers after the observed lessons to answer my research sub-question 3:

> What factors enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge?

5.2 Lesson observation

Observation was used to gather 'live' data that might otherwise be taken for granted or be overlooked (see Section 3.6.2.2). In this study, observations enabled me to see how the two participating teachers were able to support their learners in making sense of the topic water conservation by incorporating indigenous knowledge, which was the focus of this study.

For both Teacher 1 (Lazarus pseudonym) (T1) and Teacher 2 (Anna pseudonym) (T2), their lessons were double periods and these ran for about 70 minutes each. During both lessons, a friend videotaped the lessons for me so that I could focus on taking some field notes as the lessons progressed.

Being in the classroom, I was able to observe different teaching strategies used by the teachers when scaffolding their learners to make sense of the topic water conservation through incorporating indigenous knowledge. It also enabled me to identify factors that enable or constrain teachers when mediating learning of the topic water conservation through using indigenous knowledge.

5.2.1 Observation Teacher 1 Male: (O-T1M)

Lesson (double period)

The lesson was presented in the form of power point slides to guide teacher-learner interactions. The classroom interaction was mainly a discussion between the learners and the teacher. The teacher often posed well-structured and thought-provoking questions, for example, "*Looking at the picture, why do you think there are plants although it is dry?*" Clarity was then sought by posing follow-up questions.

The lesson started with the teacher giving the objectives of the lesson and he explained:

> ***T (Teacher)*** *"We are going to do the section in your syllabus on water conservation – and we are going to start off with this picture." [Teacher puts on power point slides and shows the picture of the objectives and competencies to be achieved as set out by the syllabus].*

The purpose was to prepare the learners for what was expected from them in this particular topic and connecting this with indigenous knowledge/local knowledge from the Topnaar community. The teacher showed his learners a picture of the desert which illustrates the scarcity of water (see

Figure 5.2.1(a)). Thereafter, he explained that the plants in the picture are scattered and not clustered. He then asked the learners why they think there are plants there although it is dry.

Figure 5.2.1 (a) Dry desert and scattered plants

Learners responded as follows:

L: Because they have adapted to live in dry conditions.
T: Can anyone give me some features of plants that have adapted to live in dry conditions?
L: They store water, they grow rapidly, and they have thorns to reduce transpiration.
T: Can you give me the names of desert plants that have adapted to live in dry conditions?
L: !Nara and welwitschia plant and camelthorn.

Learners' answers were quite insightful, but as the lesson was a power point presentation the teacher just acknowledged that that they answered well although he did not summarise it on the chalkboard.

Thereafter, the teacher introduced the local Topnaar expert to explain how they conserve water in the desert using local knowledge. The use of the Topnaar expert (interpreter and one who possesses indigenous knowledge held by his community), resonates with Klein's (2011) study with the Nama people in the south of Namibia about making use of local people during lesson presentations. Notably, this was suggested by the teachers during their co-development of lessons as they were unable to go with me to conduct interviews due to their work commitments. A study done by Snively and Corsiglia (2001) as well as Shizha (2007), indicated that the systemic and structural hierarchies should stop seeing alternative forms of knowledge, in this case indigenous knowledge as not being scientific. This means school principals did not want to release teachers to conduct interviews at Utuseb because they regard the completion of science syllabuses important as

learners are writing cluster examinations and their schools' "image" depended on it.

Figure 5.2.1 (b) Topnaar expert explaining to learners

> ***TN (Topnaar)****: Asked learners if anyone knows the Topnaar community or have they been in that area.*
> *L: Somewhere in the desert.*
> *TN: Topnaars regard water as sacred, will save it and will always make sure that the next person has access to water.*

Herein lies the spirit of *Ubuntu* in this Topnaar community as stated in Le Grange (2012), and Mukwambo et al. (2014).

> TN: Showed pictures of Camelthorn trees growing in the riverbed which produce pods. The pods are a food source for the goats/small livestock. Showed that the !Nara plant is the most important of all as it is consumed as whole by the Topnaars and animals. Also showed the roots which has medicinal value. Stressed the value of water for the growth of the !Nara plant and trees. Showed donkey carts as a means of transport to collect and distribute water as well as the importance of the containers to store water.

The expert showed learners the spirit of *Ubuntu* (kindness, caring, neighbourly) (see Section 4.3.1), with the statement "*the Topnaars will always make sure that the next person has access to water."* This is one of the traits that is lost in our society today.

Figure 5.2.1 (c) Topnaar reliance on water for trees, goats and !Nara plant

TN: How do you in town drink your water?
L: From the taps or from the water bottles we bring to school.
TN: Why do you think the Topnaars have to store water?
L: So they can use it again.
L: It is far to collect water.
L: Water is not regularly available.

By using these questions, the Topnaar expert clearly wanted to connect to the learners' prior knowledge. Teaching that does not build on the learners' experiences prevents them from seeing the connection between the world outside the classroom and what is taught in school (Oloruntegbe & Ikpe, 2011; Stears, et al., 2003).

TN: NAMWATER extracts water. Mines need clean water. NAMWATER supplies water to towns, fishing factories and mines. Explain how water gets to the coast from the highlands of central Namibia. Water sinks in the dry riverbeds. Heavy extraction of NAMWATER makes it impossible for Topnaars and plants to get to water source underground. This causes a problem for the Topnaars as the trees and !Nara plants cannot grow meaning no food source for the goats. Shows picture of small containers.
TN: Think about how much water do you use at home per day? Do you really need 80litres to bath in?
LLL (Learners responded in a chorus): No.
TN: Topnaars use small containers to wash and re-use water by pouring it under trees or under extreme cases like the drought currently they will use the water to wash their clothes.

Figure 5.2.1 (d): The importance of using containers

The Topnaar expert showed to the learners the importance of using containers to collect, save and measure water consumption.

TN: Do you know how water gets to your tap?

LLL: No
TN: Explained the process of how expensive it is to get water to the houses and school so that you just open the tap. Topnaars realised long ago the importance of saving water for them to survive for their children and children to come so they can also benefit from the Kuiseb River. That is why they will use about a 20 litres of water for a week.
L: How did their forefathers store water?
TN: Ostrich eggs, put piece wood in the opening and place under tree with a marker to keep cool. They could not carry water around in the desert. Left water under trees not for themselves but for somebody else. People move up and down in the desert and they know where to find water as a marker was placed at the spot where the water was. Later they made clay pots to store water in.
T: Showed learners a video clip about rain falling in central Namibia and how it comes down through the desert to the coastal town. The clip also indicates the importance of this rain water for the Topnaars their livestock, the !Nara plants and trees growing in the desert.

He showed a clip with images on how water is wasted in their local community and explained the images to the learners instead of asking learners to identify how water is wasted.

Figure 5.2.1 (e) How water is wasted in local community

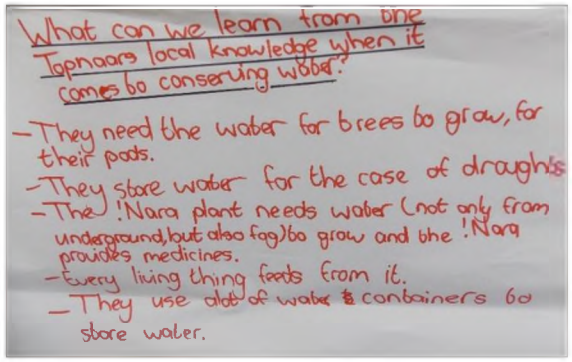
L: Explains that she observes in one of the pictures also how water is wasted by bathing.
T: Is there any water conservation practices at our school?
LLL: Report leaking taps. Make sure water taps are closed.
T: Water conservation is everyone's business. Can someone explain how the water cycle works?
L: Evaporation, water moves to clouds, clouds get heavy rain falls and it moves from the highlands to the coast.

Lazarus gave the learners an opportunity to work in groups and discuss what they have learned and at the same time to see if his mediation on the topic water conservation using indigenous

knowledge from the Topnaar community was understood. He gave these guiding questions to scaffold learners in their discussions.

a) *Why do we need to conserve water?*
b) *How can we conserve water at school and at home?*
c) *What can we learn from the Topnaar's local knowledge when it comes to conserving water?*

The third question was of utmost importance to see whether learners from School A understood the indigenous knowledge possessed by the Topnaars. See learners' answers below.



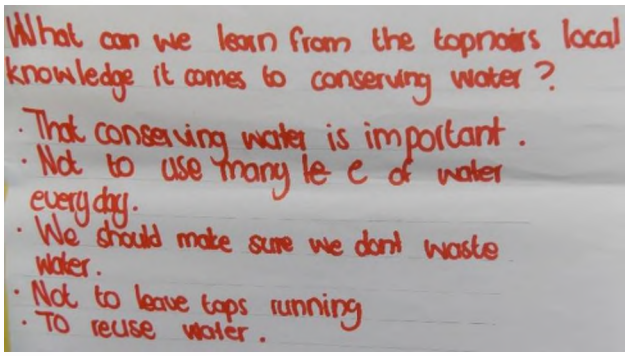


Figure 5.2.1 (f) School A: leaners answers on IK possessed by Topnaars

At School A, the learners' answers indicate that the Topnaars' existence depends on water, especially the plants which are necessary to sustain their livestock and the !Nara plant for their own livelihood. The use of containers to store water was also mentioned as it is a commodity normally thrown away by people in urban areas, as if they had no use.

5.2.2 Observation Teacher 2 Female: (O-T2F)

Lesson (double period)

As both teachers co-developed the lessons, they were presented in the form of power point slides to guide teacher-learner interactions (This is in line with the social cultural theory of Vygotsky). The classroom interaction was mainly a discussion between the learners and the teacher. For example, he explained that "*I am going to talk about the importance of water conservation basing our topic on indigenous knowledge (IK). Knowledge that has been passed on by our forefathers*". Clarity was then sought by posing follow-up questions.

Anna first greeted the learners before commencing with the lesson. The lesson was then introduced by her saying:

T (Teacher): "I am going to talk about the importance of water conservation basing our topic on indigenous knowledge (IK). Knowledge that has been passed on by our forefathers and I am going to concentrate more on the Topnaar people who lives in the desert. You know that Namibia is a dry country which receives low rainfall." She immediately relates to the current drought experienced by the country and why it is so important to conserve water. She then gives the objectives of the lesson and competencies as set out by the Natural Science syllabus.

The purpose of this was to prepare the learners for what was expected from them in this particular topic and connecting this with their prior everyday knowledge. This complements Kuhlane's (2012) idea which states that "it could be argued that learners come to class with different understandings and knowledge bases gained from different experiences. It is such knowledge and experiences that could help learners inform new ideas during learning processes" (p. 15). Anna used an interesting approach to prevent the topic from being isolated from other topics using the Levels of Organisation as elicitation of prior knowledge. She then shows the picture of the desert asking leaners to identify what they see, which was a different approach to Lazarus. For instance, Anna told learners what the picture explained whereas Lazarus asked his the learners to explain what they saw in the picture and they responded as follows:

LLL (Learners answer in a chorus): The desert
T: Can you see how scattered the trees are and how dry it is? Can you see the Topnaar people living there?
LLL: Yes

Anna showed her learners a picture of the Topnaar community member and me when I went to investigate their water practices.

Figure 5.2.2 (a) Expert and I having interviews

This was intended to make learners understand that there are people within their community who possess local indigenous knowledge on how to conserve water in particular. The teachers and I hoped to develop a better understanding of the role of indigenous knowledge in science teaching especially the topic water conservation.

> *T: Shows picture of the resources the Topnaar community rely on. "What type of tree do you see?"*

Instead of explaining, she rather asked the learners to identify the tree to see what prior knowledge they have (see Figure 5.2.1 (c)).

> *L: !Nara Tree*
> *T: No, it's a camel thorn tree.*
> *T: She explains the pods on the trees and the value to the small livestock. As well as the fleshy part of !Nara melon that can be eaten as it contains water. She explains the root that contains water which is drank by people as a means of medicine and supplementing water. Explain the donkey cart with containers to deliver water and that the Topnaar household live from 20 litres or less water per day.*

Similarly, Anna made effective use of power point slides on the screen to explain the Topnaar's reliance on water. The reason was to give ample time on elicitation of prior knowledge as seen below. This took place mainly in the form of the question-answer method as well as active participation through discussion between teacher and learners. Anna posed well-sequenced questions, guiding to a better level of understanding. There was a good poise between teacher and learner talk.

> *T: Where do you get water from? The water that comes from your taps. Anna*
> *L: NAMWATER*
> *T: Where does NAMWATER get their water from?*
> *L: From underground.*
> *T: Explain how water gets to the coast through rainfall on the highlands in central Namibia... NAMWATER drill and the Topnaars suffer as the trees and Nara cannot reach the water table underground. No water for the livestock and Nara to grow on which they depend.*

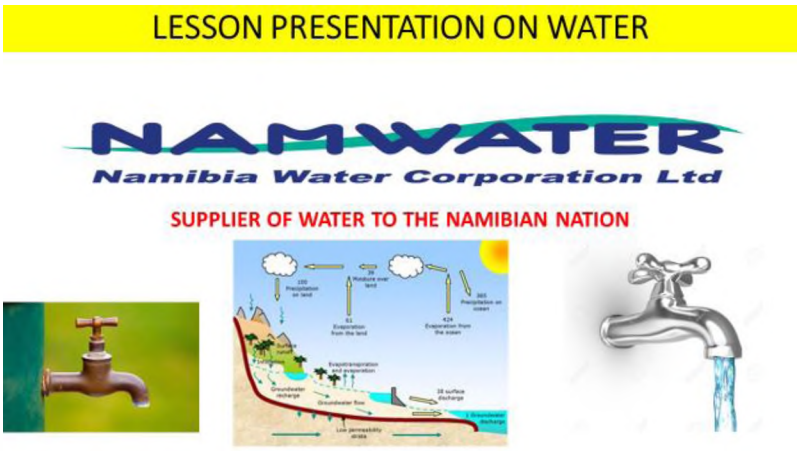


Figure 5.2.2 (b) NAMWATER: How water reach our homes?

T: Shows a video of rainfall in Namibia and how the water gets through the desert.

The video coincided with Figure 5.2.2 (b) to give learners a perspective that if there is drought in central Namibia, there will not be any flow of water to the coastal area which in turn affects the Topnaars' livelihood like their goats, !Nara harvesting and the Topnaars themselves.

T: Show image of water being wasted? Is water used wisely at our school?

LLL: No

T: How is it wasted?
L: Taps are left open. Cleaner's washing windows with hosepipe. Children play with water. Don't use cups to drink water.
T: Look at pictures and identify ways how water is wasted.
L: Taps leaking. Bath instead of shower. Brush teeth leaving tap running. Wash car with pipe instead of bucket. Illegal car washes.
T: How many illegal car washes in Walvis Bay.
LLL: Hundreds.
T: How can we safe water using the knowledge from the village which your grandparents showed you? I want to hear from people from the north. Don't think of the western way.
L: Use the same bath water all boys and girls.
L: Wash hands in container everyone. After eating they use the same water to wash hands.

As proposed by Roschelle (1995), Anna was connecting learners' prior knowledge, (see Section 2.4) with what they know was happening in the villages. She was further trying to remind learners about what indigenous knowledge is as proposed by Warren (1991, 1992), Flavier (1995), and Ellen and Harris (1996) (see Section 2.5), by saying, knowledge as used by your grandparents to save water. Answers given by learners show peer interaction with the teacher controlling these interactions with well sequenced questioning creating a collaborative zone of proximal development. Vygotsky (1978) (see Section 2.6.1). This also linked up with the learner-centred

approach whereby learners were active participants, Nyambe (2008) (see Section 2.2).

T: Introduction of Topnaar expert to talk about their water practices.

Figure 5.2.2 (c) Topnaar expert explaining their water practises

Anna introduced the Topnaar expert later in the lesson whereas Lazarus introduced him early in the lesson.

TN: How many of you know about people living in the desert?
LLL: No response.
TN: If you are in town or at school you just go to a tap when you thirsty. Topnaars are confined to the environment with no taps. Industries have caused water to get scarce in the desert. NAMWATER biggest of scarcity. Ancestors/forefathers dug holes in desert half a meter and scoop water with wood or clay to get water. Nowadays it is impossible because water levels dropped. Plastic containers important nowadays to store water as there are only certain water points.
TN: How much water do you need to bath?
L: 50 litres
TN: Showing images of containers. Topnaars use a small container to wash themselves.

The Topnaar expert showed to the learners the importance of using containers to collect, save and measure water consumption.

TN: Water is not about themselves but the next person. That is why they save water. Water was traditionally stored in eggs. Use what nature provided. Will know where to find water as it is placed under trees for the next person. Clay pots were also made to store water. Animals are given water in small containers to save water. They only wash once a day in a small container.

With the statement "*Water is not about themselves but the next person*", the expert showed learners the spirit of *Ubuntu* (kindness, caring, neighbourliness) as proposed by Le Grange (2007) and Mukwambo, et al. (2014). In my view, this is one of the qualities that is lost in our society today.

L: How is NAMWATER extracting water and how does it influence the Topnaar.

TN: Water is extracted to supply the mines, industries and households. The water levels drop and the trees and Nara plant cannot get water. If the trees don't have water they cannot produce pods for our livestock. If the Nara plant cannot grow we will not have melons as our staple food and the peels for our livestock. All animals need the Nara melons as it is a water source. The roots have medicinal value.
T: Anna gave the learners an opportunity to work in groups and discuss what they have learned and in the same time see if her mediation on the topic water conservation using indigenous knowledge from the Topnaar community was understood.

The lesson concluded with a group activity.

See questions posed by teacher one at the end of his lesson. Question three was of utmost importance to see whether learners understood the indigenous knowledge possessed by the Topnaars. See attached answers from School B.

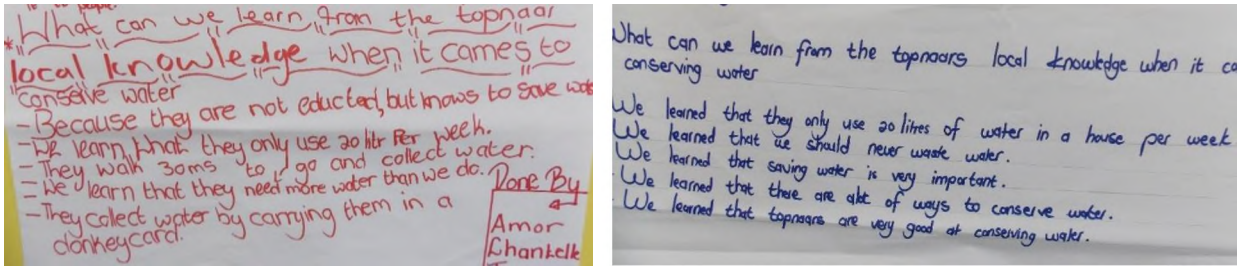


Figure 5.2.2 (d) School B – leaners answers on IK possessed by Topnaars

What emerged from the learners' answers above was the use of containers to save water and how much water is used by the Topnaar people per week.

Summary based on the lessons observed

The use of the Topnaar expert as a strategy to involve learners was innovative as he gave learners a greater understanding of the indigenous knowledge possessed by his community. It could be concluded that the use of an expert was an attempt by the teachers to try out other teaching methods to mediate learning of the topic water conservation using indigenous knowledge. Furthermore, methods such as the elicitation of prior everyday knowledge, the use of learning and teaching support materials (LTSMs) such as the power point slides and projector as well as group work was an effective attempt by teachers to help learners make sense of the topic water conservation using indigenous knowledge. The teachers and expert managed to relate the learners' every day experiences by relating it to their usage of water at home and at school (Oloruntegbe & Ikpe, 2011).

It was clear that this strategy kept the learners interested and actively involved during the lessons. The use of the power point with pictures assisted in keeping the lesson alive and interactive. It was clear that the content explained by both teachers and the Topnaar expert was clear and understandable as required from the syllabus. Furthermore, concepts such as water conservation and indigenous knowledge, were clearly explained to the learners. According to learners' answers in response to questions asked by the teachers and expert, as well as questions asked by some learners, it was clear that conceptual development of most learners was on a par with the content covered. It was clear that most learners had some insights in the topic.

In view of my research questions below, four analytical statements were drafted for analysis with themes, data sources, indicators, theories and literature as evidence as shown in Table 5.3 (a), (b) and (c). Interpretation and discussions were informed by the theories of Vygotsky (1978) and Shulman (1986). These analytical statements were mainly inductively developed in expectancy that they would give concise answers to research question two. Out of them I made my concluding remarks and recommendations regarding my study which was to explore the possibility of integrating local indigenous knowledge in the teaching of the topic on water conservation by senior primary Natural Science teachers.

5.3 Analytical statements to answer research sub-question 2

Table 5.3 (a): Shows the analytical framework (themes, analytical statements, data sources, for research sub-question 2 [RQ 2] to be answered)

RQ 2: How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water? (Lesson observations)		
Emerging themes	**Analytical Statements**	**Data sources**
Learning approaches	1. Teaching Pedagogy: Strategies used by teachers to scaffold learners in making sense of concepts water conservation and indigenous knowledge. Prior knowledge	Document analysis, Lesson observation and Teacher interviews
Social interaction	2. Social interaction are vital for inclusion of indigenous knowledge in Natural Science.	Teacher interviews and Lesson observation
Teacher-learner interaction	3. Scaffolding within the ZPD of the learners improve conceptualisation of concepts.	Lesson observation Teacher interviews
Challenges faced during mediation of learning	4. Can PCK help teachers mediate the learning of the topic water conservation using indigenous knowledge?	Teacher interviews, Lesson observation

The following is a brief description of the codes mentioned in Table 5.1(b)

Code	Explanation
O-T1M	Observation Teacher 1 Male (Lazarus)
O-T2F	Observation Teacher 2 Female (Anna)
I-T1M	Interview Teacher 1 Male
I-T2F	Interview Teacher 2 Female
I-TN	Interview Topnaars

Table 5.3 (b): Shows the themes, analytical statements, indicators and evidence to answer research sub-question 2

RQ 2: How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water? (Lesson observations)			
Emerging themes	**Analytical statements**	**Indicators**	**Evidence (from the data)**
Supporting strategies	1. Teaching Pedagogy: Strategies used by teachers to scaffold learners in making sense of concepts water conservation and indigenous knowledge.	pedagogical strategies	O-T1M; O-T2F I-T1M; I-T2F
Social interaction	2. Social interaction are vital for inclusion of indigenous knowledge in Natural Science.	Learners work together through group work with teachers as facilitator.	O-T1M; O-T2F I-TN I-T1M; I-T2F
Teacher-learner interaction	3. Scaffolding within the ZPD of the learners improve conceptualisation of concepts.	teachers' intervention techniques and methods	O-T1M; O-T2F
Challenges faced during mediation of learning	4. Can PCK help teachers mediate the learning of the topic water conservation using indigenous knowledge?	issues/ conditions influencing classroom interactions and teachers' choice of interactions	O-T1M ;O-T2F I-T1M; I-T2F

Table 5.3 (c) Analytical statements and supporting theory/literature in relation to RQ 2

RQ 2: How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water? (Lesson observations)	
Analytical Statements	**Theory/literatures**
1. Teaching Pedagogy: Strategies used by teachers to scaffold learners in making sense of concepts water conservation and indigenous knowledge. (Prior Knowledge, Co-planning of lessons, National curriculum & LCE)	Nyambe (2008); Stears, Malcolm and Kowlas (2003); NCBE (2010)
2. Social interaction are vital for inclusion of indigenous knowledge in Natural Science.	Vygotsky (1978); Lemke (2001); Leontiev (1978); Cole (1996)
3. Scaffolding within the ZPD of the learners improve conceptualisation of concepts.	Vygotsky (1978); Stott (2016)
4. PCK may help teachers mediate the learning of the topic water conservation using indigenous knowledge.	Shulman (1987); Van Driel, Verloop and De Vos (1998)

The following section discusses the analytic statements that emerged from the data as indicated in Table 5.3.

5.3.1 Analytic Statement 1:

Strategies used by teachers to scaffold learners in making sense of concepts water conservation and indigenous knowledge

In Chapter 2, I reasoned, using Vygotsky's (1978) suggestion, that from a social constructivist perspective, learner-centred education (LCE) involves recognition of the role played by learners' sociocultural contexts in shaping the knowledge and world views that they bring to the classroom. In addition, using the Pedagogical Content Knowledge (PCK) theory (see Section 2.7.2), I reasoned that the strategies a teacher uses to transfer a particular content are influenced by the teacher's understanding of the content and the learning challenges of the learners. Based on that, I observed several teaching strategies utilised by the participant teachers during their lesson presentations.

The presentation in this section has three sub-sections: The National Science Curriculum and Learner-centred education, teachers draw on prior knowledge as a mediating technique, and co-planning of lessons.

5.3.1.1 The National Science Curriculum and Learner-centred education

In Chapter 2, the Namibian Curriculum for Basic Education (2010) document is viewed as a guideline that informs all stake holders on the national expectations in terms of the quality of education in the country. What I learned in this document is that it purports that learning should start with what learners already know (NCBE, 2010). Additionally, the national curriculum document outlines that the content to be taught should be made relevant to learners' everyday lives. That is, the goal of education in Namibia is to enable learners and transform the nation into a knowledge-based society. This means the NCBE encourages teachers to use different knowledges i.e. that the "the concept of knowledge embraces indigenous knowledge and local and national culture as well as international and global culture" (NCBE, 2010:7). This was well introduced by Anna when she started her lesson.

> *"I am going to talk about the importance of water conservation basing our topic on indigenous knowledge (IK). Knowledge that has been passed on by our forefathers and I am going to concentrate more on the Topnaar people who lives in the desert"* (O-T2F; 2-5).

There is a section in the same document in which specific basic competencies are briefly outlined. These refer to what learners should be able to do at the end of a certain phase. Under natural sciences, however, there is no basic competence that talks about values that are attached to cultural beliefs. A study conducted by Stears, Malcolm and Kowlas (2003) outlined that learners experience difficulties in aligning what they learn in science with their prior everyday experiences. During my interview with both Lazarus and Anna, they indicated that the curriculum should include indigenous knowledge as there is value to it.

> *"Yes, definitely. Namibia is a country with diverse ethnic groups. Different culture groups can each add value for example the different science topics. Walvis Bay is a multi-cultural town. Many learners were so proud to share their cultures experiences during the lesson. It will make the lessons fun".* (Appendix H: I-T1M; 31-34).

Anna added that: *"Yes, coming from the north where I grew up in the village our culture has many IK as other Namibian cultures which can be of value to science teaching"* (Appendix H: I-T2F; 35-36).

In relation to pedagogical issues, the curriculum acknowledges the fact that learners do best when

they are actively involved in the learning process. Throughout the analysis of my findings I noticed that both teachers attempted to some degree to use a learner-centred approach through the use of the question and answer method and group work as strategies to scaffold learners to make sense of the concepts on water conservation and indigenous knowledge. Thus, teachers are urged to be creative in making learning meaningful to learners. Concurring, Nyambe (2008) urges teachers, from a learner-centred (LCE) perspective, to structure their lessons in ways that facilitate and encourage active learner and involvement in the pedagogic process. Teachers 1 and 2 gave the learners an opportunity to work in groups and discuss what they have learned and in the same time see if his mediation on the topic water conservation using indigenous knowledge from the Topnaar community was understood. (Appendix G1: O-T1M; 81-83); (Appendix G2: O-T2F; 98-100). I observed that that teachers knew how to make use of the learner centred approach to get learners involved.

Organising and structuring one's lessons to get learners involved means teachers must be knowledgeable about their subject content. With the knowledge teachers have on subject content (Shulman, 1987), they are likely to facilitate effective learning that moves learners from their everyday experiences to what they are presented with in the science classroom. Teachers 1and 2 started their lessons with the following statement showing that they are well acquainted with the subject content as prescribed in the NCBE (2010) and syllabus.

> *"We are going to do the section in your syllabus on water conservation – And we are going to start off with this picture. (Teacher puts on power point slide and shows the picture of the objectives and competencies to be achieved as set out by the syllabus)".* (Appendix G1: O-T1M; 8-10).

> *"You know that Namibia is a dry country which receive low rainfall. She immediately relates to the current drought experienced by the country and why it is so important to conserve water. She then gives the objectives of the lesson and competencies as set out by the Natural Science syllabus".* (Appendix G2: O-T2F; 6-8).

I can conclude by saying that after analysing documents, lesson observations and interviews that the indigenous knowledge can be successfully incorporated by teachers, but the curriculum should be adapted to give guidance to teachers in doing so.

5.3.1.2 Drawing on prior knowledge

> Neglect of prior knowledge can result in the audience learning something opposed to the educators' intentions, no matter how well those intensions are executed in an exhibit, book or lecture (Roschelle, 1995, p.1).

With this statement, Rochelle asserts the importance of elicitation of prior everyday knowledge as the starting point for constructing new knowledge in our science classrooms. This echoes well with the NCBE's (2010) view which states that learners are not empty vessels and that they possess a variety of experiences when they come to school and Vygotsky's (1978) social-cultural theory which purports that all learners can only manage to create new knowledge or meanings based on what they have previously experienced. Vygotsky theorizes that mediated learning is the action of social interaction between teacher and learner in the enrichment of the students learning experience.

In Vygotsky's mediation process, a teacher mediates meaning by acting as a medium of symbolic mediation. Especially at primary school level, it is the role of the teacher primarily to 'fascinate' learners to learn science. As Anna emphasised during the interview, when asked whether the workshop provided sufficient information regarding the Topnaars indigenous knowledge on water conservation to be included in the lesson:

> "*As a teacher I could relate to my upbringing in the village and incorporate it in the lesson, even the Grade 6 learners could relate to that. I now realise the value of my grandparents' upbringing in the village about conserving water"* (Appendix H: I-T2F; 7-9).

Drawing from the lesson observations, it was noted that both teachers are aware of the importance of the elicitation of prior knowledge as a strategy in the mediation of learning. However, they implemented this strategy totally different from one another, probably as a result of educational qualification and creativity (see Section 4.2). Anna (who grew up in the villages knew how her grandparents taught them to conserve water) succeeded in this as she started her lesson by saying:

> *"I am going to talk about the importance of water conservation basing our topic on indigenous knowledge (IK). Knowledge that has been passed on by our forefathers and I am going to concentrate more on the Topnaar people who lives in the desert"* (Appendix G2: O-T2F; 2-4).

This immediately gave learners an understanding what indigenous knowledge was as they could

draw on the knowledge their grandparents taught them in the villages. As highlighted in Section 2.4, a number of researchers emphasised the importance of the elicitation of prior knowledge in the classroom (Oloruntegbe & Ikpe, 2011; NCBE, 2010; Roschelle, 1995). Stears, et al. (2003), for example, reason that learners are more involved in classroom discussions if they have experiences to share. Throughout the lesson, Anna continuously drew on prior knowledge as she reflected back on the indigenous knowledge possessed by their grandparents on water conservation. On the contrary, Lazarus never reflected back on prior knowledge during mediation of learning of the topic.

> *T: How can we save water using the knowledge from the village which your grandparents showed you? I want to hear from people from the north. Don't think of the western way.*
> *L: Use the same bath water all boys and girls.*
> *L: Wash hands in container everyone. After eating they use the same water to wash hands.*
> (Appendix G2: O-T2F; 63-66).

Using questions throughout the lesson, Anna adheres to the viewpoint of Stears, et al. (2003), suggesting that prior knowledge may be used effectively in different phases of the teaching and learning process. This may be the reason why the learners engaged freely with the teacher and in this way took control of their own learning. It could therefore be concluded that for prior knowledge to be applied successfully during the mediation of learning, the teacher needs to plan carefully. This brings me to my final strategy co-teaching of lessons as a tool for learners to make sense of the concepts water conservation and indigenous knowledge.

5.3.1.3 Co-teaching and co-planning of lessons

In Section 4.4.5, I discussed co-teaching, also called collaborative teaching by (Bouck, 2007; Crow & Smith, 2005), as a method of instruction that can assist teachers to successfully incorporate indigenous knowledge into the teaching of the topic water conservation. Although the participant teachers were in possession of lesson plans, schemes of work, syllabuses and curriculum documents, they were initially not sure on how to incorporate indigenous knowledge in the teaching of the topic water conservation. Hence, the co-teaching method and workshop was introduced as an intervention and continuing professional development of teachers to improve their teaching skills and developing new methods of teaching to successfully incorporate indigenous knowledge in the teaching of the topic water conservation. Additionally, the workshop was intended to make the concepts of indigenous knowledge and western knowledge clearer to

teachers. It also gave teachers an opportunity to discuss the descriptions of IK, plan on how to co-teach and on how to incorporate it in their teaching of the topic water conservation.

For my two research participants, the shared experience of co-teaching sparked conversations that enlightened their personal values and assumptions about teaching and learning that they were unaware of, in this case the introduction of IK into the teaching of the topic water conservation. The workshop, co-planning and teaching was intended to indicate the type of teaching aids to be used, details of the subject content to be covered and role of the teacher and that of the learners as well as details of a well-structured homework. Such planning is required so that unnecessary mistakes and errors can be avoided during the presentation of the lesson.

Although I have presented my data in Chapter 5, I will repeat a few examples to reinforce the findings regarding the two teachers' co-teaching and planning and other strategies employed during their lesson presentation.

> *"Yes, I was more relaxed as I was part of the planning of the lesson and also know how to use the power point, projector and pointer"* (Appendix H: I-T1M; 12-13).
> *"Definitely, I felt confident and knowledgeable about the topic and knew how to use the interactive media such as the projector, pointer and slides"* (Appendix H: I-T2F; 14-15).
> *"Introduction of Topnaar expert to talk about their water practices"*. (Appendix G2: O-T2F; 72-73)

Evidence from my lesson observations and interviews with both teachers have shown the benefits of co-teaching and planning.

5.3.2 Analytic Statement 2:

Social interactions are vital for inclusion of indigenous knowledge in Natural Science

Language is an essential tool when teacher scaffold learners in assisted learning to be able to do the tasks successfully without any delay. The social interaction teachers had with the researcher and Topnaar expert helped them to be knowledgeable about the Topnaars water practices and made it easier for them to incorporate IK into the teaching of the topic water conservation.

In Section 2.6, I described the theory of social constructivism which underpins my study, drawing from the work of Vygotsky (1978). Lemke (2001) who supports Vygotsky's theory stated that we

should view "science education, and research on science education as human social activities conducted within institutional and cultural frameworks" (p. 296). Vygotsky and Lemke stress the importance of social interactions between the teacher and learners, and this notion forms the basis of social constructivism.

Lazarus is Damara/Nama-speaking and Anna is Oshikwanyama-speaking, meaning they have different cultural backgrounds and possess different forms of cultural knowledge. The social interaction they had with the Topnaar expert helped them to include indigenous knowledge of the local people in their lesson presentations. This was observed in the lessons for both teachers when they taught the topic water conservation using indigenous knowledge. This corresponds to the research done by Kuhlane (2011) and Kambeyo (2012) in South Africa and Namibia respectively. The social interaction teachers had with the Topnaar expert helped them to gain knowledge about the water practices of the Topnaar community. During the lessons I observed that Anna was more knowledgeable about indigenous knowledge than Lazarus.

For instance, Anna started her lesson by saying: *"I am going to talk about the importance of water conservation basing our topic on indigenous knowledge (IK). Knowledge that has been passed on by our forefathers and I am going to concentrate more on the Topnaar people who lives in the desert"* (Appendix G2: O-T2F; 2-4), as well as during the lesson frequently referring to the knowledge passed on by their forefather through question and answer methods, *How can we safe water using the knowledge from the village which your grandparents showed you? I want to hear from people from the north. Don't think of the western way.* (Appendix G2: O-T2F; 63-46).

During interaction with learners, Lemke (1990) urges teachers to formulate questions in such a way that inspires learners to participate in conversation instead of only responding to the question. In brief, the cognitive levels of questions asked by the teacher should stimulate social interaction between teacher and learners. In this manner, what emerged from the lesson observations was that, although Lazarus often posed questions of higher cognitive demand, they were mainly short-answer questions and did not really guide the learners to take part in the conversation. Anna, on the other hand, mainly asked questions in the form of complete sentences resulting in learners answering in full sentences individually, showing clear understanding of the concepts.

"T: How can we safe water using the knowledge from the village which your grandparents showed you? I want to hear from people from the north. Don't think of the western way.
L: Use the same bath water all boys and girls.
L: Wash hands in container everyone. After eating they use the same water to wash hands".
(Appendix G2: O-T2F; 63-66).

The effective use of the power point slides and video as well as the Topnaar expert assisted in improving conceptual understanding of concepts water conservation and indigenous knowledge. Both teachers attempted to encourage social interaction between teacher and learner in posing questions throughout the lesson. Interaction between peers and teacher at the end of the lesson (see Figures 5.3.2 below) created better opportunities for learners to talk in small group (Lemke, 1990) and write about their experiences in science for improved cognitive understanding (Mc Robbie & Tobin, 1997).

Figure 5.3.2 (a): T2F-O School B

Figure 5.3.2 (b): T1M-O School A

5.3.3 Analytic Statement 3:

Mediation of learning and the ZPD to improve learners' conceptualisation of concepts.

As different scaffolding techniques used by the teacher, viz., National Curriculum Documents, learner-centred education, prior knowledge, co-teaching and planning, social interaction were discussed in detail under Sections 5.3.1 and 5.3.2 This section will focus on how, if at all, scaffolding took place within the ZPD of the individual learners.

In Section 2.7.1 I elaborated in the context of school learning that Vygotsky states that a child's development within a ZPD involves social interaction, dialogue, and mediated activity between learners and with their teachers (Vygotsky, 1978).

I totally agree with Stott (2016), when she adapted Del Rio and Alvarez's (2007, p. 281) model as it gives a better understanding of Vygotsky's ZPD and clearly states what has been learned in the ZPD by learners and teachers.

Below I give an outline from Stott's adapted model to show what learners and teachers have learned in the ZPD (Stott, 2016, p.31). I have used two of Stott's adapted elements to explain who learns or develop in the ZPD and with what or how is it learned.

5.3.3.1 Who learns or develops in the ZPD?

In my lesson observation it became clear that both teachers and learners learned. This is evident in the questions and answers given by Anna.

> *"I am going to talk about the importance of water conservation basing our topic on indigenous knowledge (IK). Knowledge that has been passed on by our forefathers and I am going to concentrate more on the Topnaar people who lives in the desert"* (Appendix G2: O-T2F; 2-4)
> *T: How can we save water using the knowledge from the village which your grandparents showed you? I want to hear from people from the north. Don't think of the western way.*
> *L: Use the same bath water all boys and girls.*
> *L: Wash hands in container everyone. After eating they use the same water to wash hands.* (Appendix G2: O-T2F; 63-66).

During the lesson observations of Anna, it was clear that she managed to create and maintain the ZPD of the learners. I found that Anna posed questions of higher cognitive demand as seen above. When learners were answering questions, she guided each learner according to his or her cognitive development. It made learners feel comfortable in this environment and they were able to communicate in order to develop a better conceptual understanding of concepts.

5.3.3.2 With What/How it is learned?

A collaborative ZPD is based on the idea that each partner possesses some knowledge and skills but requires another person contribution to make progress (Goos, Galbraith & Renshaw, 2002). In my interview it was clear that with the help of the expert, teachers learned and the learners were able to make sense of the concepts indigenous knowledge and water conservation.

Researcher: Was the use of a Topnaar expert beneficial to the mediating of the topic water conservation using IK?

"Yes, the expert brought a sense of cultural pride and identity back to the learners. His knowledge about his culture on how they have survived in the desert for hundreds of years made me realise how intelligent and much knowledge exist within the different Namibian culture groups. The fact that I could not go to the Topnaar community because of my school schedule made it easier for the leaners to grasps the importance of water conservation using IK because he did it very well "(Appendix H: I-T1M; 18-23)

"Definitely because me and the learners could relate to our own culture. I felt very proud to be Oshiwambo as I could relate how my grandparents teaching us how to conserve water. He talked with so much proudness about his culture and how their knowledge made them survive in the desert for hundreds of years. He was beneficial as I could not go physical to the Topnaars because of working conditions and time schedule of my school" (Appendix H: I-T2F; 24-28).

In conclusion, I applaud the argument of Stott (2016) that current researchers should view the ZPD in the broader context of Vygotsky's development theory, as the elements she developed can play an indispensable role in creating a ZPD for effective mediation of learning. It gave me as a researcher a better understanding of what was learned by learners and teachers

5.3.4 Analytic Statement 4:

PCK may help teachers mediate the learning of the topic water conservation using indigenous knowledge

In Section 2.6.2, I explained in detail what PCK entails. Based on Schulman's (1986) theory, PCK is about applying the best strategies in the mediation of learning of specific topics to make it comprehensible to the learners and to clear up certain misconceptions learners may have about a topic**.**

We live in a visual world. Text used to be the message medium of choice, but since most people no longer have the time or patience to digest large reams of text, increasingly dense information packages have become the norm in the form of video clips, power point slides, pictures etcetera. This includes teachers' contextualized understanding of how best their learners learn and therefore treating them as such. With such views in mind, it could be argued that effective teaching and learning would take place only when teachers understand and are familiar with the learning styles of the learners and teaching methods are guided by such understanding. It goes without saying that learners are exceptional individuals and their abilities in terms of how best they learn are reasonably diverse.

My findings in this study showed that the two participant teachers understood their learners and more strength was observed during the lesson presentation. During their planning for co-teaching the teachers thought is wise to make use of a laptop and projector for power point slides and video clips, and the Topnaar expert as neither could visit the Topnaar community at Utuseb. This in line with Shulman (1987) which states that PCK is "the blending of content and pedagogy into an understanding of how particular topics, problems or issues are organised and adapted to the diverse interests and abilities of learners and presented for instruction" (p. 8).

Each teacher started their lesson presentation with a picture which shows water scarcity. This clearly indicates that both teachers know the interest and abilities of their learners. Learners have become visual beings and are easily attracted to media of pictures. Lazarus immediately explained the picture, demonstrating his knowledge of his learners' capabilities. In contrast, Anna asked learners to identify what they saw in the picture as a strategy to engage learners.

The introduction of the Topnaar expert at different stages of their lessons is an indication of the teachers knowing their students' diverse capabilities. Additionally, the use of the video clip during the lesson was a way of both teachers to keep the learners interested during the lesson. They suggested that learners learn better when they are able to relate to something they are familiar with. As such, they felt that teachers should be able to refer to real-life examples. That is, they observed that meaning was constructed by the individual as new information interacts with extant knowledge.

The two teachers' views echo those of Stears, et al. (2003). These scholars' studies produced evidence that the use of prior knowledge in the science classroom increases the levels of engagement of learners, and that learners enjoy making links between their different experiences when curriculum is designed to facilitate such links. Lemke (2001) also suggests that to we should see science education as a human social activities conducted within institutional and cultural framework, giving meaning to social interaction (see Section 2.6.1). There is a need to strike a balance between 'teacher talk' and 'learner talk' that is why the use of the video clip and expert during the lesson gave better meaning to the concepts water conservation and indigenous knowledge.

In Section 5.3.1.3, I described the findings regarding the co-teaching and co-planning of lessons by the participant teachers. Based on the analysis of their lesson plans, I concluded that there was consistency in the co-teaching and co-planning, and details of what exactly would be the role of the teacher and that of the learners as well as the incorporation of media into the lessons to make the mediating of the concepts easier for learners. PCK therefore can help teachers making meaning to the concepts water conservation and indigenous knowledge. This is evident in the answers below given by learners on IK possessed by the Topnaar during their group discussions (see Sections 5.2.1 and 5.2.2).

5.4 Best practices observed from the two teachers during their lesson presentations

The best practices that were observed were the use of different mediational tools as proposed by Vygotsky (1978) such as laptops, projectors and power point slides to make the concepts IK and water conservation clear by both teachers. Additionally, the Topnaar expert was involved during these lessons as proposed by Klein (2011). As a result, learners were actively involved during the lessons to discover the indigenous knowledge possessed by the Topnaar community. Learners were also given an opportunity to work in groups and elaborate on the indigenous knowledge possessed by Topnaar community members and also how they can conserve water.

The use of question and answer method was useful in involving the learners during the lessons because teachers were giving learners opportunities to answer questions. Some questions were testing the IK of learners during the lessons and it gave the teachers knowledge on which topics learners have a lack of IK or prior knowledge. Furthermore, this allowed the teachers to help the learners to gain a deeper understanding of new concepts by asking them. Similarly, learners were also afforded an opportunity to ask questions.

5.5 Semi-structured interviews with teachers

The second stage of my study entailed having semi-structured and stimulated recall (SRI) interviews with teachers after the observed lessons to answer my third research question:

> What factors enable and/or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge?

The purpose of conducting these interviews was to find out factors that enable and/or constrain the

teachers in mediating learning of the topic water conservation through using indigenous knowledge in particular.

5.5.1 Interviews with T1M (I-T1M)

The interview with Lazarus was in the format of an informal discussion of the interview questions as the researcher can make the questions clear and it is easier for the respondent to talk than to write long responses through a questionnaire (Bertram and Christiansen, 2015). For him the workshop information provided enough information on indigenous knowledge for the level of the learners and himself "*but not how indigenous knowledge can relate to science because as I grew up in urban area and was taught the western way of science in school"* (see Appendix H; I-T1M: 5). As discussed in Section 4.4, the purpose of the workshop to introduce the concepts western science and indigenous knowledge and discuss or make suggestions on how to incorporate IK and WS into the lessons with the IK found in the Topnaar community. He further stressed that co-development and co-teaching provided a platform for him to be more relaxed with the researcher and to know how to use the learners' support material (LTSM). He explained as follows: "*and also know how to use the power point, projector and pointer"* (Appendix H; I-T1M: 12-13).

Although Lazarus was confident in teaching, and teaching this topic specifically, the following factors came from my interview and SRI with him which can enable or constrain the mediating and learning of the topic water conservation using local indigenous knowledge.
These will be dealt with in a summary below.

5.5.1.1 Factors which can enable the mediating and learning of the topic water conservation using local indigenous knowledge

> *"Yes, I was more relaxed as I was part of the planning of the lesson and also know how to use the power point, projector and pointer"* (Appendix H; I-T1M: 12-13).

> *"Yes, the expert brought a sense of cultural pride and identity back to the learners"* (Appendix H; I-T1M: 18).

> *"As this is only Grade 6 learners, the information was enough for their level of understanding. For me as a teacher it was also relevant as I had an idea what IK was"* (Appendix H; I-T1M: 3-4).

> *"I think it will give value to our African culture as many learners growing up in urban areas are already losing their traditional values"* (Appendix H; I-T1M: 39-40).
>
> *"Indigenous Knowledge can help with local sustainability. Indigenous Knowledge and Western Science can be taught together as we have seen with our lesson presentation"* (Appendix H; I-T1M: 60-61).
>
> *"Learners find IK so interesting they talked about other forms of IK used by their elders in the village. Their questions and answers during the lesson as well as the answer given to question 3 indicated that they understood the value of IK"* (Appendix H; I-T1M: 68-69).

Based on the above statements made by Lazarus, I could clarify that the following factors as stated by Teacher 1, would benefit the inclusion of IK when mediating the topic water conservation:

- Co-development and teaching of lessons;
- The use of TLSM (teacher learning support material), like the laptop and projector. And
- The use of a Topnaar expert who possesses IK used by his community.

As the inclusion of indigenous knowledge (IK) in the topic water conservation is introduced, the teacher and Topnaar expert as the more knowledgeable persons, as well as the use of TLSM's can assist the learners in understanding and integrating the new concepts obtained from the Topnaar community members faster and more efficiently. This means that teachers need adequate lesson planning preparation to mediate the ZPD (Vygotsky, 1978; Stott, 2016) in teaching the topic water conservation with the inclusion of IK.

5.5.1.2 Factors which can constrain the mediating and learning of the topic water conservation using local indigenous knowledge

Contextual and curriculum issues and time management

> *"Time and management members that are not sensitive cultural issues. Currently our science curriculum does not include indigenous knowledge. We are driven by a scheme of work and syllabus which gives little time to include IK"* (Appendix H; I-T1M: 47-49).
>
> *"Teachers, therefore only focus on their syllabus to finish it and drill learners to pass their exams"* (Appendix H; I-T1M: 55-56).

According to Shizha (2007), teachers rely on documented information and accept it as authentic knowledge. He further concluded that problems for effectively incorporating indigenous knowledge in science teaching was rooted in institutional demands and aims of education as

perceived by educational administrators (p. 316). This means teachers are examination-driven and will not make time for alternative teaching as it is not included in the syllabus. Furthermore school managements think about their schools' "image" and are therefore concerned with the period available for teachers to finish syllabus on time and prepare learners for examinations.

5.5.2 Interviews with T2F (I-T2F)

This interview started with the teacher being asked how she experiences teaching the water conservation with the inclusion of indigenous knowledge (IK). She indicated that this topic is really easy to teach as she and the learners could relate to their experiences in the village. To this end, Anna commented that:

> "*As a teacher I could relate to my upbringing in the village and incorporate it in the lesson, even the Grade 6 learners could relate to that"* (Appendix H; I-T2F: 7-8).

Although Anna was confident in teaching this topic specifically, the following factors came from my interview and SRI with her which can enable or constrain the mediating and learning of the topic water conservation using local indigenous knowledge.

These will be dealt with in a summary below.

5.5.2.1 Factors which can enable the mediating and learning of the topic water conservation using local indigenous knowledge

> *"Definitely, I felt confident and knowledgeable about the topic and knew how to use the interactive media such as the projector, pointer and slides"* (Appendix H; I-T2F: 14-15).

> *"Definitely because me and the learners could relate to our own culture. I felt very proud to be Oshiwambo as I could relate how my grandparents teaching us how to conserve water"* (Appendix H; I-T2F: 24-25).

> *"As a teacher I could relate to my upbringing in the village and incorporate it in the lesson, even the Grade 6 learners could relate to that"* (Appendix H; I-T2F: 7-8).

> *"It will give a sense of pride to learners when they talk about the knowledge their elders possess. How they cured diseases using certain roots or leaves"* (Appendix H: I-T2F: 43-44).

> *"Integrating IK into Science Curriculum can save our planet and environment for the next generations. It can make lessons interesting. Learners can bring certain traditional resources when certain science topics are discussed"* (Appendix H: I-T2F: 62-64).

"Learners were exited and even asked questions not related to the topic on water conservation but related to other science topics. Their answer to question 3 and questions and answers during the lesson indicated they value Indigenous knowledge" (Appendix H; I-T2F: 70-72).

The above statements from Anna are in agreement with the comments given by Lazarus on factors which enable the mediating and learning of the topic water conservation with the inclusion of IK. (see Section 5.3.1.1)

5.5.2.2 Factors which can constrain the mediating and learning of the topic water conservation using local indigenous knowledge

Contextual and curriculum issues and time management

"Time. Teachers have only five periods per week for science. IK is not included in the curriculum" (Appendix H; I-T2F: 50-51).

"Our syllabus and textbooks are written from a western perspective not having any views on IK." (Appendix H; I-T2F: 57-58).

The above statements from Anna are in agreement with the comments given by Lazarus on factors which constrain the mediating and learning of the topic water conservation with the inclusion of IK (see Section 5.3.1.2).

During the stimulated recall interview, I asked Anna was to comment on what she could have done differently. She identified spreading the content over more days to prevent leaping between concepts; more effective conceptualisation of concepts as well as allowing more time to direct learners properly in writing summaries when doing group work.

From data collected via interviews, I gained some insights into the teachers' view of scaffolding learners in the mediation of learning of the water conservation using indigenous knowledge (IK). Teachers also managed to indicate some of the problems they faced in teaching this topic. In view of my research questions below, two analytical statements were drafted for analysis with themes, data sources, indicators, theories and literature as evidence as shown in Table 5.6 (a), (b) and (c). Interpretation and discussions were mainly informed by the data generated. These analytical statements were mainly inductively developed in the expectation that they would give concise

answers to research question three. Out of them I made my concluding remarks and recommendations regarding my study which was to explore the possibility of integrating local indigenous knowledge in the teaching of the topic on water conservation by senior primary Natural Science teachers.

5.6 Analytical statements to answer research question 3

Table 5.6 (a): Shows the analytical framework (themes, analytical statements, data sources, for research sub-question 3

RQ 3: What factors enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge? (Interviews with teachers)		
Emerging themes	**Analytical Statement**	**Data sources**
Availability of resources and how it benefits the teachers.	Factors that encourage teachers to include or not include indigenous knowledge in the lessons	Teacher interviews
Teacher/learners prior everyday knowledge, teacher experiences and community involvement	Advantages and disadvantages that affect science teachers' views and experiences on the inclusion or not including indigenous knowledge in their daily lessons	Teacher interviews

Table 5.6 (b): Shows the themes, analytical statements, indicators and evidence to answer research sub-question 3

RQ 3: What factors enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge? (Interviews with teachers)			
Emerging themes	**Analytical statements**	**Indicators**	**Evidence (from the data)**
Availability of resources and how it benefits the teachers	Factors that encourage teachers to include or not include indigenous knowledge in the lessons.	Different types/forms of mediational tools to teach the subject/ topic. Co-development of lessons Time management, curriculum issues	I-T1M I-T2F
Teachers/learner prior everyday knowledge, teacher skills and community involvement	Advantages and disadvantages that affect science teachers' views and experiences on the inclusion or not including indigenous knowledge in their daily lessons.	Contextual issues/ conditions affecting classroom interactions and teachers' choice of interactions.	I-T1M I-T2F

Table 5.6 (c): Analytical statement and supporting theory/literature to answer RQ 3

RQ 3: What factors enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge?	
Analytical Statements	**Theory/literatures**
Factors that encourage teachers to include or not include indigenous knowledge in the lessons.	Klein (2011); Stears, Malcolm & Kowlas (2003); Nyambe (2008)
Advantages and disadvantages that affect science teachers' views and experiences on including or not including indigenous knowledge in their daily lessons.	McCallum (2012); NCBE (2010); Mukwambo (2014); Shizha (2007); Kibirige and Van Rooyen (2006); Ocholla and Onyancha (2005); Turnbull (1997)

I now discuss these analytical statements below.

5.6.1 Analytic Statement 1:

Factors that encourage teachers to include or not include indigenous knowledge in the lessons

I will first start by mentioning the factors which encouraged teachers to include IK in their lessons mentioned by both teachers during my interview with them. These included the co-planning and teaching of lessons, TLSM, and the use of a Topnaar expert. Evidence by teachers is shown below:

> *"Yes, I was more relaxed as I was part of the planning of the lesson and also know how to use the power point, projector and pointer". "* (Appendix H; I-T1M: 12-13).
> *"Definitely, I felt confident and knowledgeable about the topic and knew how to use the interactive media such as the projector, pointer and slides"* (Appendix H; I-T2F: 14-15).

The above statements made by both teachers indicates that co-planning and teaching of lessons is of vital importance for the success of lessons as we live in a visual age. The use of the power point slides as mediating tools also ensured that learners could understand the topic better. Nyambe (2008) urges teachers, from a learner-centred perspective, to structure their lessons in ways that facilitate and encourage active learner participation and involvement in the learning process.

Lazarus and Anna also felt that the Topnaar expert made a huge impact as both learners and teachers could draw their prior knowledge and make a connection between the world outside and the classroom (Stears, et al., 2003).

> *"Yes, the expert brought a sense of cultural pride and identity back to the learners. His knowledge about his culture on how they have survived in the desert for hundreds of years made me realise how intelligent and much knowledge exist within the different Namibian*

culture groups. The fact that I could not go to the Topnaar community because of my school schedule made it easier for the leaners to grasps the importance of water conservation using IK because he did it very well" (Appendix H; I-T1M: 18-23).

Anna added that: *"Definitely because me and the learners could relate to our own culture. I felt very proud to be Oshiwambo as I could relate how my grandparents teaching us how to conserve water"* (Appendix H; I-T2F: 24-25). Klein (2011) also indicated in his study amongst the Nama people in the south of Namibia that teachers can complement their formal teaching by including local knowledge by local community members.

Secondly, I highlight the factors which discourage teachers from including Indigenous Knowledge in their lessons.

> *"Time and management members that are not sensitive to cultural issues. Currently our science curriculum does not include indigenous knowledge. We are driven by a scheme of work and syllabus which gives little time to include IK"* (Appendix H; I-T1M: 47-49).
> *"Time. Teachers have only five periods per week for science. IK is not included in the curriculum"* (Appendix H; I-T2F: 24-25).

Mukwambo, et al. (2014) argue that we should be mindful that IK is not a bag of knowledge waiting to be tapped in and dispensed. This means that time is needed to carefully dismantle which Indigenous Knowledge to include in our curriculum. Schemes of work and syllabuses are time-bounded, which does not make provision for the inclusion of IK. Many management members are not sensitive to cultural issues and think from a western perspective, regarding IK as adding no value to the academic performance of learners and the school.

5.6.2 Analytic Statement 2:

Advantages and disadvantages that affect science teachers' views and experiences on including or not including indigenous knowledge in their daily lessons.

Advantages

In Section 2.2, I stated that one of the aims of the NCBE is to develop an environmentally sustainable society (NCBE, 2010, p. 8). Lazarus and Anna were asked to give the advantage of including indigenous knowledge in their lessons. This question was well answered by both participants from the semi-structure interviews. The advantages of including IK mentioned by the participants are:

> *"I think it will give value to our African culture as many learners growing up in urban areas are already losing their traditional values. It will give learners a sense of*

understanding, respect and appreciation for other learner's cultures and in the meantime enriching themselves with other cultures Indigenous Knowledge" (Appendix H; I-T1M: 47-49).
"It will give a sense of pride to learners when they talk about the knowledge their elders possess" (Appendix H: I-T2F: 24-25).
"Different culture groups can each add value for example the different science topics. Walvis Bay is a multi-cultural town. Many learners were so proud to share their cultures experiences during the lesson. It will make the lessons fun" (Appendix H; I-T1M: 47-49).
"Yes, coming from the north where I grew up in the village our culture has many IK as other Namibian cultures which can be of value to science teaching" (Appendix H; I-T2F: 24-25).

The interviews with Lazarus and Anna revealed that the advantages of including IK in Natural Science lessons can:

- *Give value, a sense of pride, respect, understanding and appreciation for our African culture;*
- *Make lessons fun/interesting and add value to science teaching;*
- *Help with local sustainability and save the planet.*

Lazarus and Anna agree that the inclusion of Indigenous Knowledge in Natural Science lessons may improve learners' understanding on how science relates to their culture (Turnbull, 1997) as well as saving our planet for future generations (McCallum, 2012). The finding suggests that teachers need to include Indigenous Knowledge in their lessons as it can bring back cultural pride and identity which has become lost in urban towns (Cocks, Alexander & Dold, 2012). Kibirige and Van Rooyen (2006); Ocholla and Onyancha (2005) agree that Indigenous Knowledge is a legacy of knowledge and practice unique to a particular group of people, practices that have been developed and passed on over generations.

Disadvantages

In Section 2.5.6, Mukwambo et al. (2014) stated that most science concepts are not yet developed and therefore the curriculum influence teachers not to see the need of incorporating IK in their science lessons. Data generated from my interviews with my two research participants suggests that Indigenous Knowledge might also have disadvantages when included in the Natural Science lessons.

"Time and management members that are not sensitive to cultural issues. Currently our science curriculum does not include indigenous knowledge. We are driven by a scheme of work and syllabus which gives little time to include IK" (Appendix H; I-T1M: 47-49).
"Time. Teachers have only five periods per week for science. IK is not included in the

curriculum" (Appendix H; I-T2F: 24-25).

"We live in a society which are measured by results. Teachers are measured by their results. Teachers, therefore only focus on their syllabus to finish it and drill learners to pass their exams as all primary school are writing the same Natural Science paper" (Appendix H; I-T1M: 47-49).

"Our syllabus and textbooks are written from a western perspective not having any views on IK" (Appendix H; I-T2F: 24-25).

The interviews with Lazarus and Anna revealed that the disadvantages of including IK in Natural Science lessons are:

- *Management members are not sensitive to cultural issues;*
- *Curriculum does not include IK;*
- *Scheme of work and syllabus are time driven;*
- *Measured by examination results; and*
- *Textbooks, syllabus are written from a western perspective.*

Both teachers were of the opinion that as textbooks are written from a western perspective, the inclusion of IK in Natural Science lessons may influence the learners as it is not documented in the textbooks (Shizha, 2007). Schools in Walvis Bay are writing the same cluster papers and are measured according to their results. Inclusion of IK may therefore need extra time as it is not well developed in the curriculum. Management members are rated on the performance of the examination results and are therefore not sensitive to cultural issues.

5.7 Concluding remarks

The study revealed that both teachers involved in this study in the Walvis Bay circuit understood the importance of the inclusion of IK in their lessons. However, they also pointed out at the challenges that teachers face when integrating IK in their lessons. During my lesson observation and interviews it became evident that co-planning and co-teaching play an important role regarding the successful inclusion of Indigenous Knowledge in science lessons. Likewise, the use of local experts from the community as proposed by Klein (2011) is crucial for effective inclusion of IK in lessons as learners' interest to talk about IK possessed by their culture and grandparents was evoked.

In the next chapter, I provide a summary of the findings of my study, make recommendations, suggest areas for future research, and discuss the limitations of my research study. I further reflect critically on my research journey and conclude by formulating some conclusions.

CHAPTER SIX: SUMMARY OF FINDINGS, RECOMMENDATIONS AND CONCLUSION

The summary will identify the key factors, key issues, key concepts and key areas for subsequent investigation. It is a watershed stage during the data collection, as it pinpoints major themes, issues and problems that have arisen, so far, from the data and suggest avenues for further investigation (Cohen, Manion & Morrison, 2011, p. 568).

6.1 Introduction

In Chapters 4 and 5, I presented, analysed and discussed the data generated from interviews with the Topnaar community, lesson observations and interviews with teachers. In this chapter, I present a summary of the research findings, recommendations, areas for future research and research limitations as stated in my epigraph above by Cohen, et al. (2011). Lastly, the chapter concludes with my personal reflections of my research journey.

The main focus of this study was to explore the possibility of integrating local indigenous knowledge in the teaching of the topic water conservation by senior primary school Natural Science teachers. I thus present the summary of my findings in accordance with my following research sub-questions:

a) What local indigenous knowledge on water conservation is found in the Namibian Topnaar community?

b) How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water?

c) What factors enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge?

6.2 Summary of findings

Research sub-question 1: What local indigenous knowledge on water conservation is found in the Namibian Topnaar community?

What emerged from my interviews with the Topnaar community was the strong sense of identity, belonging and a collective sense of being. They think of the individual in the context of relationships with fellow human and natural realms. The people express a closeness to and dependency on nature for nourishment. This concurs with Le Grange, (2012, p. 8) who states that, "*ubuntu* (humanness) is a concrete expression of *ukama*, that is, humanness needs to be understood relationally. In other words, humanness is an expression of interconnectness between people

themselves, and between people and the biophysical world".

The indigenous knowledge in Utuseb are governed by the ideals of *Ubuntu* as reiterated Le Grange (2012) and Mukwambo et al. (2014). The principles of *Ubuntu* are part of the fabric of rural communities. These principles include: respect, communalism, interdependence, supportiveness, solidarity, cooperation, caring for others, kindness, neighbourly support and participation for the common good (Hamminga, 2005; Louw, 2004; Malcolm & Alant, 2004). Broodryk (2006) view *Ubuntu* as the basis of the African worldview.

Therefore, Indigenous Knowledge as found amongst the Topnaar at Utuseb is universal, emphasising relationships and interconnectedness. Integration efforts that recognise local knowledge as a *system* will have taken a step towards *valuing* it. The use of the Topnaar expert as part of the lesson presentation clearly shows the spirit of *Ubuntu* (kindness, caring, neighbourly, respect) to the learners when he said:

> *"The Topnaar will always make sure that the next person have access to water"* (Appendix G1: O-T1M; 36-37) & (Appendix G2: O-T2F; 89-90).

The values of respect for both people and the environment; a sense of community; awareness of the local environment; and the strong relationship between the social and the physical are of particular importance among the Topnaar participants. The inclusion of such values in science teaching and learning would be consistent with what the Topnaars and teachers want, and would be in line with the recommendations of those who advocate for culturally relevant pedagogy. Stears, et al. (2003) suggest that teachers, community members and curriculum designers must work together to write materials that are culturally relevant.

Research sub-question 2: How can Grade 6 Natural Science teachers mediate learning of the topic water conservation using local indigenous knowledge about water?

This research sub-question had four analytical statements focusing on best strategies teachers use to mediate learning of this topic. The findings specify that both teachers attempted to practice a learner-centred approach during their teaching of the topic. According to this research, the intention of using learner-centred approach was executed well. The study revealed that Lazarus and Anna used the question and answer method, group work and learning and teaching support

material. Additionally, they also used the Topnaar expert to help the learners grasp the lesson content on water conservation incorporating indigenous knowledge. The teachers' usage of different teaching strategies is important in the classroom where a learner-centred approach is being practised in an attempt towards learning the concepts related to indigenous knowledge and water conservation with understanding (Nyambe, 2008).

I found Lazarus and Anna were trying their best in the mediation of learning of abstract concepts in order for learners to make sense of these concepts. Their pedagogical content knowledge (PCK) (Shulman, 1986) empowered teachers to make the subject content comprehensible to their learners ensuring concepts were clearly understood.

The Topnaar community member's talk on how they save water improved the teaching of the topic water conservation as the learners found it exciting and interesting. His talk connected with the teachers' and learners' prior knowledge in the classroom and increased the levels of engagement of learners. Furthermore, the learners enjoyed making connections between different experiences and that facilitated meaningful learning (Stears, et al., 2003).

Overall, the co-development and planning on how to incorporate indigenous knowledge into the teaching of water conservation lesson facilitated co-learning amongst all of us.

Research sub-question 3: What factors enable or constrain Grade 6 Natural Science teachers in mediating learning of the topic water conservation using local indigenous knowledge?

In answering the research sub-question three, the findings revealed that teachers are influenced by different factors to include indigenous knowledge in their science lessons. I first started by mentioning the factors which encouraged teachers to include IK in their lessons mentioned by both teachers during my interview with them. Lazarus and Anna supported the idea of involving the community member (Topnaar expert) in the learning of science. Lazarus and Anna stated that sometimes community members can teach both learners and teachers something. Similarly, learners and teachers could also do the same for the community members. This means, there is a mutual benefit in working with local communities. Interaction with the Topnaar community could build a strong bond between schools and the community. Furthermore, this interaction and

integration of knowledge could help the science teachers develop good teaching strategies which would enable learners to grasp the topic water conservation with the inclusion of indigenous knowledge. These included the co-planning and teaching of lessons, LTSMs and the use of a Topnaar expert. Proper planning is needed to incorporate IK into science lessons as it may clear up misconceptions that may arise from indigenous knowledge (Maselwa, 2004). Furthermore, the teachers suggested that the inclusion of indigenous knowledge in their lessons can bring back cultural pride and identity (Cocks, Alexander & Dold, 2012; Webb, 2013).

However, there were also some constraints mentioned by the Lazarus and Anna. That is, the curriculum and curriculum designers do not make provision for the incorporation of IK as mentioned by (Reis & Ng-A-Fook, 2010). Both teachers were of the opinion that textbooks are written from a western perspective and that the inclusion of IK in Natural Science lessons may influence the learners as it is not documented in the textbooks (Shizha, 2007). Furthermore, schools in Walvis Bay are writing the same cluster papers and are measured according to their results. Inclusion of IK may therefore need extra time as it is not well developed in the curriculum. Management members are rated on the performance of the exam results and are therefore not sensitive to cultural issues.

More positive comments emerged than negative comments about the incorporation of IK into science lessons.

6.3 Recommendations

Drawing on the findings of this study some issues emerged that need to be addressed in the field of science on indigenous practices that could be included in science lessons to enhance learners' understanding. These are as follows:

- Teachers and curriculum planners should explore different indigenous practices that are link to the topics in the curriculum or syllabus to enhance learning and teaching. By doing this they need to involve the local community member that have advanced indigenous knowledge to help in delivering the lessons (Klein, 2011).
- Teachers, curriculum developers and community members should start developing different materials that are useful when local knowledge is included. Looking at the

syllabus for Natural Science Grade 4-7 there is less prominence when it comes to the inclusion of indigenous knowledge in the curriculum for the Ministry of Education, Art and Culture (MoEAC).

- Curriculum developers with the help of subject advisors, teachers and community members must start planning on how best indigenous knowledge can best integrated into science textbooks as it has become hindrance for the teachers to incorporate it. Terminologies in textbooks needs to be developed in the local language.
- Advisory teachers should train management members on the incorporation of indigenous knowledge in science lessons in order to create awareness of the value of IK for sustainable use of our resources. In his study amongst the Xhosa people, Webb (2013, p. 89) suggests that there was a "shared awareness of the value of indigenous knowledge across the respondents (teachers, pupils, and community members) and the reason as to why it is important to include it into the school curriculum was to remind children of, and develop respect for, their heritage".
- Documenting of indigenous knowledge should be suggested to ensure future generation benefit from it.
- IK conferences should be encouraged by local government and the Ministry of Basic Education Arts and Culture to improve interaction and discussion between schools and local communities (Klein, 2011).

6.4 Areas for future research

This case study forms a useful platform for future research in the following areas:

- A similar study could be conducted, but with inclusion of learners as research participants.
- The effect of indigenous knowledge on the Science curriculum towards the performance of senior primary learners in Namibia.
- Research could be conducted on the effectiveness of co-planning and teaching on the incorporation of indigenous knowledge in science lessons.

6.5 Limitations of my study

Being a case study of only two Natural Science teachers in the Erongo Region, the findings of this study cannot be generalised; however, it provided some insights into how teachers can mediate

learning of the topic water conservation with the inclusion of indigenous knowledge.

Two lessons were recorded, together with the interviews, so analysing the data was time-consuming and this might have led to my overlooking valid information. Likewise, travelling to Utuseb was difficult as we had a tyre puncture and we had to turn back as it was a gravel road. I had to wait for the permission letter from the Chief of the Topnaars before I could go to Utuseb as he was visiting his daughter in America. On arrival at Utuseb, I found many of the community members were at the !Nara fields, meaning I had to drive long distances to find community members to conduct interviews which limited my interviews to only ten community members.

The other limitation was time constraints. For instance, being a teacher and management member made life difficult for me and took me out of my planned schedules to observe and conduct interviews. Most time was spent on attending workshops and other managerial activities. I had to reschedule the program for the interviews several times.

6.6 Reflection on my research journey

This research journey started in 2015 when I was enrolled at Rhodes University. When I came for my interview in October 2014, Prof Ken Ngcoza introduced me to an article on indigenous knowledge and that captivated my interest, especially on how it could be incorporated in science lessons.

When my proposal was approved I was excited that the journey into the real world of researchers had opened as I had spent ample time reading up about concepts of mediation of learning, abstract concepts, scaffolding, ZPD, *etcetera* (concepts that I have never heard of before!).

However, after my research proposal was accepted, the practical implementation and implications became a reality. I had to deal with some predicaments early on in my journey, such as a research participant who could not continue as she transferred to another region because her husband was promoted. I decided on choosing research participants from different schools, one a public school and one semi-private. Due to many public holidays and long weekends, participant teachers were more than a month behind teaching schedule, putting a lot of pressure on me to gather my data on

time. This meant principals rescheduled my visit to their schools to the third term.

Conducting pilot interviews and observations guided me in formulating and re-formulating my interview questions. As concepts that I overlooked or did not acknowledge as important, arose during interviews and lesson observations with my research participants, I had to adapt and add to my literature review accordingly. At times it seemed that nothing really made sense and then it was amazing to find how concepts and data unfolded and came together as the process continued. Through this process, I have developed a number of key skills. I have learnt that it is of utmost importance to establish a good rapport with each research participant, particularly when the study is of a qualitative nature and cooperation between researcher and teachers and Topnaar expert. Furthermore, I realised that the questions as well as follow-up questions asked in an interview can be crucial in gathering data and that this requires certain skills and experience for the interview to be fruitful. I have learnt that the researcher has to develop extremely fine observation skills during interviews, lesson observations and document analysis to be able to analyse the data critically and make appropriate interpretations. Then, I have learnt how to put ideas together logically to form patterns that make sense to the reader. Lastly, I have developed new insights about teaching and learning; skills that I can now pass on to fellow teachers for them to become competent teachers in science education.

If I had to conduct such a study again, I would research more before finalising my research topic, taking into consideration the research participants' willingness to work with me and the time slot in the school calendar for this topic to be covered. In doing this, I believe that I would be able to reduce my frustrations and, perhaps, the limitations of the study. During the analysis of my data, I found that the interviews I had with the Topnaar community members did not come out clearly as I would have wished for it was windy and this affected the audio sound on the camera. Luckily I had made some field notes as a back-up. I would also consider taking study leave for the year while writing my thesis, to have ample time to focus only on my studies.

Being a MEd student has enabled me to develop new insights about my own teaching and my view of education in particular. The course work, magnified my view of life in general and appreciation for other cultures. Lastly, by doing this MEd course I came to learn the words of Prof Ken

Ngcoza's favourite African Proverb which says:

"If you want to go fast, walk alone. But if you want to walk far, walk together".

6.7 Conclusion

In this chapter, I discussed the findings in relation to each research sub-question by highlighting the main findings, recommendations, limitation of the study, area for further research and reflection on my research journey.

The study revealed that both teachers in Walvis Bay circuit understood the importance of IK in their lessons, thus they were willing to include it during their Natural Science lesson topic on water conservation. Both teachers understood the significant role of IK in their lessons and the benefits that come with the inclusion of IK, however they also pointed out at the challenges that teachers faces when integrating IK in their lessons.

During lesson observation I discovered that IK could be introduced successfully if lessons are co-planned and co-taught. For this I suggest that teachers should plan properly before incorporating IK in their lessons as to clear up misconceptions that might arise during lesson presentations. I emphasised the importance to the teachers about making use of community members that are more knowledgeable when introducing certain topics at it makes teaching more fun and interesting.

Research has also shown that for meaningful learning to take place, teachers should develop a strong PCK in order to have the best strategies in place to mediate learning of this topic effectively. It also suggests that teachers need to be knowledgeable in their subject content knowledge and be mindful of the incorporation of learners' prior knowledge and experiences into their teaching and learning practices.

This study finally suggests that their need to be networking between teachers in order to develop on their subject content knowledge as well as pedagogical content knowledge to be able to make use of different teaching styles as they support learners in the process of making sense of abstract science concepts and indigenous knowledge in particular.

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Appendix 1(a) Permission request letter to the Regional Director

Appendices

P O Box 1976
Walvis Bay
Namibia
Cell: 0812773050

18 February 2016

The Director of Education
Erongo Region
Private Bag 5024
Swakopmund

Dear Mr J Awaseb

PERMISSION TO CONDUCT RESEARCH FOR A MASTERS DEGREE IN SCIENCE EDUCATION

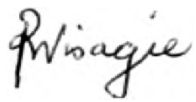
I am a registered student for the Masters of Education (Science Education) with Rhodes University. As part of the fulfilment of the Masters programme, I am required to conduct a research.

Against this background, I am requesting for permission to conduct a research at two senior primary schools (Tutaleni Primary and Duneside Private High) in Walvis Bay. The aim of this study is to understand how two Grade 6 Natural Science teachers perceive and use indigenous knowledge in their classrooms to teach the topic on water conservation. This interpretive research study will be carried out in collaboration with a rural community in Erongo region.

It is envisaged that the study will apply ethical procedures as no personal information regarding those who participate will be publicised. Furthermore, participation will be voluntary, school academic programmes will in no way be disrupted and the researcher undertakes to share the outcome of the study with the regional directorate on request.

I am looking forward to a favourable response in this regard.

Yours sincerely



Ronald A. Visagie
Head of Department (Natural and Social Sciences)
!Nara Primary School

Appendix 1(b) Permission request letter to the Topnaar Chief

P O Box 1976
Walvis Bay
Namibia
Cell: 0812773050

18 February 2016

The Chief of the Topnaar Community
Erongo Region
Walvis Bay

Dear Chief Seth Kooitjie

PERMISSION TO CONDUCT RESEARCH FOR A MASTERS DEGREE IN SCIENCE EDUCATION

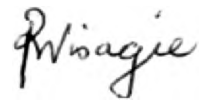
I am a registered student for the Masters of Education (Science Education) with Rhodes University. As part of the fulfilment of the Masters programme, I am required to conduct a research.

Against this background, I am requesting for permission to conduct a research with two teachers with input of the Topnaar community at Utuseb. The aim of this study is to understand how two Grade 6 Natural Science teachers perceive and use indigenous knowledge (local knowledge) in their classrooms to teach the topic on water conservation.

It is envisaged that the study will apply ethical procedures as no personal information regarding those who participate will be publicised. Furthermore, participation will be voluntary, community programmes will in no way be disrupted and the researcher undertakes to share the outcome of the study with the local Topnaar community on request.

I am looking forward to a favourable response in this regard.

Yours sincerely



Ronald A. Visagie
Head of Department (Natural and Social Sciences)
!Nara Primary School

Appendix 1(c) Permission request letter to the Principal School A

P O Box 1976
Walvis Bay
Namibia
Cell: 0812773050
18 February 2016

The Principal and School Board
Duneside Private High School
P O Box 1189
Walvis Bay

Dear Ms Einbeck

PERMISSION TO CONDUCT RESEARCH FOR A MASTERS DEGREE IN SCIENCE EDUCATION

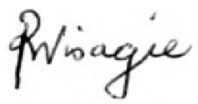
I am a registered student for the Masters of Education (Science Education) with Rhodes University. As part of the fulfilment of the Masters programme, I am required to conduct a research.

Against this background, I am requesting for permission to conduct a research at your school. The aim of this study is to understand how two Grade 6 Natural Science teachers perceive and use indigenous knowledge in their classrooms to teach the topic on water conservation. This interpretive research study will be carried out in collaboration with a rural community in Erongo region.

It is envisaged that the study will apply ethical procedures as no personal information regarding those who participate will be publicised. Furthermore, participation will be voluntary, school academic programmes will in no way be disrupted and the researcher undertakes to share the outcome of the study with your school on request.

I am looking forward to a favourable response in this regard.

Yours sincerely



Ronald A. Visagie
Head of Department (Natural and Social Sciences)
!Nara Primary School

Appendix 1(c) Permission request letter to the Principal School B

P O Box 1976
Walvis Bay
Namibia
Cell: 0812773050

18 February 2016

The Principal and School Board
Immanuel Ruiters Primary School
P O Box 253
Walvis Bay

Dear Ms Kavendjii

PERMISSION TO CONDUCT RESEARCH FOR A MASTERS DEGREE IN SCIENCE EDUCATION

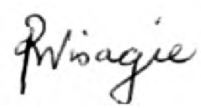
I am a registered student for the Masters of Education (Science Education) with Rhodes University. As part of the fulfilment of the Masters programme, I am required to conduct a research.

Against this background, I am requesting for permission to conduct a research at your school. The aim of this study is to understand how two Grade 6 Natural Science teachers perceive and use indigenous knowledge in their classrooms to teach the topic on water conservation. This interpretive research study will be carried out in collaboration with a rural community in Erongo region.

It is envisaged that the study will apply ethical procedures as no personal information regarding those who participate will be publicised. Furthermore, participation will be voluntary, school academic programmes will in no way be disrupted and the researcher undertakes to share the outcome of the study with your school on request.

I am looking forward to a favourable response in this regard.

Yours sincerely



Ronald A. Visagie
Head of Department (Natural and Social Sciences)
!Nara Primary School

Appendix 1(d) Permission request letter to Research Participants (Teachers, Topnaars and Expert)

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

18 April 2016

Dear Research Participant

Re: Exploring the possibility of integrating local indigenous knowledge in the teaching of the topic on water conservation by senior primary Natural Science teachers: A Namibian case study.

Thank you for agreeing to be a research participant in my study. As per our discussion, my research study is an investigation of how science teachers perceive and use indigenous knowledge in their classrooms to teach the topic on water conservation.

This interpretive research study will be carried out in collaboration with a rural community in Erongo region. Information will be gathered through semi-structured interviews followed by classroom observations to see the two teachers' and Topnaar community members' perceptions on water conservation. Additionally, I will use stimulated recall interviews (SRI) to provide clarity on how teachers elicit and integrate learners' prior knowledge and mediate learning when teaching the topic water conservation using indigenous knowledge.

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.

Sincerely

Ronald Visagie
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 1(e) Permission request letter to the Parents School A

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

03 October 2016

Dear Parent

Re: Exploring the possibility of integrating local indigenous knowledge in the teaching of the topic on water conservation by senior primary Natural Science teachers: A Namibian case study.

Your child has been selected to participate in a research study that will take place at his/her school on Wednesday 12 October 2016. The research study is an investigation on how science teachers integrate local indigenous knowledge in the teaching of the topic on water conservation.

The research study will take place after school hours between 14h00 – 15h00. This is not to infringe on official school hours. Their Natural Science teacher Mr Lazarus will be part of the lesson observation. Their participation in this research study is completely voluntary. 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.

Your help in this regard will be highly appreciated.

Sincerely

Ronald Visagie
+264 812773050
Rhodes University
MEd in Science Education Student

Dr K. Ngcoza (Supervisor)
Rhodes University

I herewith give permission for my child to take part in the research study.

Name……

Signature……

Contact number……

Appendix 1(e) Permission request letter to the Parents School B

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

03 October 2016

Dear Parent

Re: Exploring the possibility of integrating local indigenous knowledge in the teaching of the topic on water conservation by senior primary Natural Science teachers: A Namibian case study.

Your child has been selected to participate in a research study that will take place at his/her school on Tuesday 11 October 2016. The research study is an investigation on how science teachers integrate local indigenous knowledge in the teaching of the topic on water conservation.

The research study will take place after school hours between 14h00 – 15h00. This is not to infringe on official school hours. Their Natural Science teacher Ms Anna will be part of the lesson observation. Their participation in this research study is completely voluntary. 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.

Your help in this regard will be highly appreciated.

Sincerely

Ronald Visagie
+264 812773050
Rhodes University
MEd in Science Education Student

Dr K. Ngcoza (Supervisor)
Rhodes University

I herewith give permission for my child to take part in the research study.

Name……

Signature……

Contact number……

Appendix 1(a) Permission letter from the Regional Director

ERONGO REGIONAL COUNCIL

DIRECTORATE OF EDUCATION, ARTS AND CULTURE

OFFICE OF THE DIRECTOR

Telephone : 064- 4105101
Fax : 064-4105136
E-mail : dirsec@moe.org.na

Private Bag 5024
SWAKOPMUND

Enquiries : Mr. J. /Awaseb

Date : 04 March 2016

Mr. Ronald A. Visagie
P O Box 1976
Walvis Bay

Sir,

PERMISSION TO CONDUCT RESEARCH FOR A MASTERS DEGREE IN SCIENCE EDUCATION

Your request to conduct research at two schools in Walvis Bay has reference, namely Tutaleni Primary and Duneside Private High.

The request has been granted on the following conditions:

1. The principals should be approached for further arrangements with regard to dates and times.

2. As mentioned in your letter participation will be voluntary and normal school programmes will not be disrupted.

Kind regards,

ERONGO REGIONAL COUNCIL DIRECTORATE OF EDUCATION 04 MAR 2016 THE DIRECTOR PRIVATE BAG 5024, SWAKOPMUND

J. /AWASEB
REGIONAL DIRECTOR

Appendix 1(b) Permission letter from the Topnaar Chief

TOPNAAR TRADITIONAL AUTHORITY
CHIEF SETH KOOITJIE
P. O. BOX 2041
WALVISBAY
NAMIBIA
TEL/FAX: 064-207103
CELL: 0812775899
Protocol 1980/7/27 **Email:** *seth.kooitjie@gmail.com* **Reg: No T297/03**
Enquiries: Hon. Chief Seth M. Kooitjie

30th September 2016

TO: !NARA PRIMARY SCHOOL
P.O.BOX 1976
WALVIS BAY
NAMIBIA
ATT: MR RONALD VISAGIE
NATURAL AND SOCIAL SCIENCES (HOD)

Dear Sir

RE: PERMISSION TO CONDUCT RESEARH FOR A MASTERS DEGREE IN SCIENCE EDUCATION

With reference to your permission request letter dated 30th September 2016 to carry out research in the Topnaar Jurisdiction area. With the powers invested in the Chief of the Topnaar Traditional Authority, I herewith positively recommend and authorize your permission request. To

The office the chief as the supreme traditional leader humbly requests you to share the outcome of the study with my local community; provide us with a compiled report.

Please do not hesitate to contact the office of the chief for further information.

Yours in Community Development

.....
Chief S.M. Kooitjie
Topnaar Traditional Authority

TOPNAAR TRADITIONAL AUTHORITY
P.O. Box 2041 Walvis Bay
30 SEP 2016
The Chief

Appendix 1(c) Permission letter from the Principal School A

DUNESIDE HIGH SCHOOL

P.O. BOX 1189 • WALVIS BAY • NAMIBIA
TELEPHONE: 064-203782
FAX NO.: 064-204735
E-mail: secretary@dhs.com.na

Mr. R.A. Visagie
P O Box 1976
WALVIS BAY
NAMIBIA

Dear Mr Visagie

RE: PERMISSION TO CONDUCT RESEARCH FOR MASTERS DEGREE IN SCIENCE EDUCATION AT DUNESIDE HIGH SCHOOL

The purpose of this letter is to inform you that the management of the school grants permission to you in order to conduct your research at Duneside High School.

We further understand that after completion of your research project you are willing to share the information with the school.

We wish you all the best with your studies.

Sincerely,

DUNESIDE HIGH SCHOOL
Tel 064-203782 Fax. 064-204735
P.O.Box 1189
Walvis Bay Namibia

A.EINBECK
PRINCIPAL

Appendix 1(c) Permission letter from the Principal School B

IMMANUEL RUITERS J.P. SCHOOL
P.O. BOX 253, WALVIS BAY, NAMIBIA TEL.: +264 (0) 64 202675 FAX: +264 (0) 64 205992

12 OCTOBER 2016

TO: R. MR VISAGIE
P.O. BOX 1976
WALVIS BAY

RE: PERMISSION REQUESTED TO CONDUCT A RESEARCH

Permission is granted to Mr. Ronald A. Visagie to conduct a research for a Masters Degree in Science Education.

The research will involve Grade 6, Natural Science group of students and Ms. Otto the Natural Science teacher.

We wish him all the best with his studies.

Yours faithfully

MS. KAVENDJII V
PRINCIPAL

Appendix 2 (a): Interview questions for Topnaar community members

Semi Structured Interview Questions with Topnaar community members

Researcher:……..Date:……

Research Participant:……

Research site: ……..

1. How long have you and your family been staying in this area? Mention age and education.

……

2. What agricultural activities are people doing in this desert area?

……

……

3. What knowledge did the Topnaars use to survive these dry conditions?

……

……

4. What is currently putting a lot of constrain on your water resources?

……

……

5. As water plays an important part of your agricultural activities, what methods did you put in place to save or conserve water?

……

……

……

6. What is the average usage of water for your household per day and why?

……

……

7. The !Nara plant has been synonymous with the Topnaar people. What benefits does this plant have when it comes to water conservation?

……

……

8. Do you think your ways of conserving water can assist teachers, teaching the topic water conservation?

……

……

……

Appendix 2 (a): Interview transcript for Topnaar community members

SEMI-STRUCTURED INTERVIEW QUESTIONS: TRANSCRIPT TOPNAARS

Research Title: Exploring the possibility of integrating local indigenous knowledge in the teaching of the topic on water conservation by senior primary Natural Science teachers

Keys: Q: R- Question by the Researcher	
A: TN1	An **F** or **M** indicate whether the participant is male or female.
TN2 (etc)	TN – Topnaar EXAMPLE**: TN1M3 (Topnaar 1, Male, Question 3)**

Coding colors for themes	
	Spirit of Ubuntu
	Connection to Mother Earth.
	Valuing Cultural Identity.
	Health and Healing

Q1:R	**How long have you and your family been staying in this area? Age and education.**
A: TN1M1	*More than 200 years. I am staying here since my birth. I am 84 years had no formal schooling.*
A: TN2M1	*Bones discovered indicates that our forefathers had been living here for more 800-1000 years. I am staying here since birth. Am 48 years and only completed Standard 4.*
A: TN3F1	*Our ancestors have been living here for hundreds of years. I am staying here since birth. I am 87 years and never attended school.*
A: TN4M1	*Our ancestors have been staying here 500 years and more. I am 41 years and have been staying here since birth. I only completed Standard 5.*
A: TN5M1	*I have heard that our ancestors lived here for hundreds of years. I am 38 years and only completed Standard 6.*
A: TN6M1	*Our forefathers lived here hundreds of years. Lived here all my live. I am 49 years and only completed Standard 3.*
A: TN7F1	*Our forefathers lived here for a few generations. Lived here all my live. I am 48 years and only completed Standard 4.*
A: TN8F1	*The Topnaars lived here for hundreds of years. I lived here since birth. I am 51 years and only completed Standard 2.*

A: TN9M1	*Our forefathers lived here for hundreds of years. I am 27 years. Was born here. Lived in Walvis Bay to go to school but came back as family in Walvis Bay could not take care of me. I only completed Grade 8.*
A: TN10F1	*My ancestors lived here for hundreds of years. I lived here since birth. I am 65 years and only completed Standard 2.*
Q2:R	**What agricultural activities are people doing in this desert area?**
A: TN1M2	*I have a 20 goats and nature provide water and some Nara melons to harvest.*
A: TN2M2	*I have 25 goats and harvest !Nara melons to sell the pits and the roots.*
A: TN3F2	*People are having goats. I have a few but cannot harvest !Nara melons anymore.*
A: TN4M2	*Most of us are dependent on goats and the !Nara harvesting.*
A: TN5M2	*People are making a living from the small livestock (goats) and !Nara harvesting.*
A: TN6M2	*Most of us are dependent on goats and the !Nara harvesting.*
A: TN7F2	*I survive because of my small livestock and the !Nara harvesting.*
A: TN8F2	*I have about 20 goats and then I harvest !Nara melons which mother earth provides.*
A: TN9M2	*I keep goats and sell them as well as the !Nara melons I harvest.*
A: TN10F2	*I have a few goats but cannot harvest !Nara melons as I am too old.*
Q3:R	**What knowledge did the Topnaars use to survive these dry conditions?**
A: TN1M3	*Water has been regarded by my ancestors as sacred. We are part of nature. Without water our livestock cannot survive and !Nara will not grow. Water was put in ostrich egg and stored under trees to keep it cool. A special marker was placed on top so others can see it.*
A: TN2M3	*My mother told me that during times of drought !Nara melons and its roots were eaten by our ancestors instead of drinking the stored water.*
A: TN3F3	*Animal skins were placed under trees to collect the water from the fog during the night when the water levels dropped or it was too deep to dig for water.*
A: TN4M3	*I recall my father was telling me that our ancestors made clay pots to store water.*
A: TN5M3	*They ate the !Nara root or the flesh of the melon.*
A: TN6M3	*My father told me that they did not save water for themselves but they think of the next person that is why water was stored in ostrich eggs and placed at various points with a marker for people to find.*

A: TN7F3	*They regarded the Topnaar as part of nature. Water was mostly used for human consumption and for livestock. Washing was limited to save water.*
A: TN8F3	*My ancestors ate the roots of the !Nara and flesh to conserve water.*
A: TN9M3	*Roots of !Nara was eaten by our forefathers, but it was a way of quenching their thirst and it had medical value.*
A: TN10F3	*Water was stored in ostrich eggs under trees at specific places to provide for the next person.*
Q4:R	**What is currently putting a lot of constrain on your water resources?**
A: TN1M4	*The low rainfall inland and water extraction by NAMWATER.*
A: TN2M4	*I think it is NAMWATER who drains our water resources.*
A: TN3F4	*All the NAMWATER pipelines going from the riverbeds is draining our water.*
A: TN4M4	*NAMWATER Supply Company drains our water.*
A: TN5M4	*NAMWATER, mining*
A: TN6M4	*NAMWATER Supply Company*
A: TN7F4	*NAMWATER Supply Company*
A: TN8F4	*NAMWATER Supply Company*
A: TN9M4	*NAMWATER Supply Company*
A: TN10F4	*The water supply company NAMWATER.*
Q5:R	**As water plays an important part of your agricultural activities, what methods did you put in place to save or conserve water?**
A: TN1M5	*We use 20 liter water containers to store water. Only use that for the day.*
A: TN2M5	*We use containers to store water. Measure my usage of water.*
A: TN3F5	*I store water in empty containers and measure my daily usage as it is far to collect water.*
A: TN4M5	*I store water in containers and measure the usage for me and my goats.*
A: TN5M5	*I use containers and measure my daily usage.*
A: TN6M5	*I measure my daily usage and wash only every second day.*
A: TN7F5	*I keep different sizes of containers to measure my daily usage.*
A: TN8F5	*I measure my daily usage and supplement it with !Nara melons which is reach in water.*
A: TN9M5	*I supplement my water usage with eating !Nara melons which is juicy.*
A: TN10F5	*I only wash every second day and use containers to measure as it is far to collect water.*

Q6:R	**What is the average usage of water for your household per day and why?**
A: TN1M6	*I am alone so I use for myself 12 liters. There has been no rainfall.*
A: TN2M6	*I am alone so I use around 10-15 liters, can be less depend on what I am preparing. It is far to the water point and water is flowing slowly showing the water level is low.*
A: TN3F6	*I have two small grandchildren staying with me so we use 20 liters. There has been no rainfall.*
A: TN4M6	*I stay alone and for myself I use 12 Liters. Should consider my goats.*
A: TN5M6	*I stay alone and use about 13 liters. My goats need also water.*
A: TN6M6	*I use about 13 liters. There is a lack of rain.*
A: TN7F6	*I have one grandchild and we use about 15 liters. My goats also need water.*
A: TN8F6	*I have two grandchildren and we use 20 liters. We need to think of the !Nara and goats.*
A: TN9M6	*I stay alone and use about 12 liters. I save water because my goats and !Nara melons also need water.*
A: TN10F6	*I have two grandchildren staying with me. We use 20 liters. We save water because our goats need also water.*
Q7:R	**The !Nara plant has been synonymous with the Topnaar people. What benefits does this plant have when it comes to water conservation?**
A: TN1M7	*Its roots contains water it is bitter but I drink it because it is healthy, and its skin can also be eaten by the goats.*
A: TN2M7	*Its roots contains water you can drink it, and its skin can also be eaten by the goats.*
A: TN3F7	*Its roots contains water, we drink it for its medicinal value and its skin can also be eaten by the goats.*
A: TN4M7	*Its roots contains water, and its skin can also be eaten by the goats.*
A: TN5M7	*Its roots contains water, and its skin can also be eaten by the goats.*
A: TN6M7	*Its roots contains water, and its skin can also be eaten by the goats.*
A: TN7F7	*Its roots contains water with medicinal value, and its skin can also be eaten by the goats.*
A: TN8F7	*Its roots contains water, and its skin can also be eaten by the goats.*
A: TN9M7	*Its roots contains water, and its skin can also be eaten by the goats.*
A: TN10F7	*Its roots contains water and we drink it for high blood pressure and cholesterol, and its skin can also be eaten by the goats.*

Q8:R	**Do you think your ways of conserving water can assist teachers, teaching the topic water conservation?**
A: TN1M8	*Yes, we measure our consumption of water.*
A: TN2M8	*Children in towns can learn from us. We see how they waste water when we visit the town*
A: TN3F8	*Yes. They can show learners the importance of containers when of measuring the amount of water you can use.*
A: TN4M8	*They can learn from us especially if they see how far we need to go with the donkey cart to collect water. They will respect water usage.*
A: TN5M8	*Yes, Teachers can show them that we save water not for ourselves but we think also of our goats.*
A: TN6M8	*Definitely. Teachers can show them that we save water because of the low rainfall in Namibia.*
A: TN7F8	*They can learn from us as we see ourselves link with everything around us. What we do affects other living things.*
A: TN8F8	*Definitely. Without water nothing can exist. We need to save it for future generations.*
A: TN9M8	*They can learn from us because we take the low rainfall into consideration.*
A: TN10F8	*Yes they can learn to take water bottles to school to save water consumption.*

Appendix 2 (b): Interview questions with teachers after the project

Semi structured interview questions with 2 Teachers **after the project.**

Researcher:

……Date:……

Research Participant:……

1. Did the workshop and provide sufficient information regarding the Topnaars indigenous knowledge on water conservation to be included in the lesson?

……

……

2. Did the co-development of lessons benefit your presentation on the inclusion of indigenous knowledge into the topic water conservation?

……

……

3. Do you think there is value in incorporating IK/local knowledge in our science curriculum?

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4. What are your views on the inclusion of IK during NSHE lessons in Grade 6?

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5. What factors do you think influence your views on the inclusion of IK during NSHE lessons in Grade 6?

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6. What could be the reason why Grade 6 NSHE teachers do not integrate IK in their lessons?

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7. What benefits could there be for including IK into NSHE lessons?

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8. What was the response of the learners when IK/local knowledge was introduced in the lesson?

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Appendix 2 (b): Interview transcript for teachers after the project

APPENDIX H – INTERVIEW TRANSCRIPT: TEACHER 1 (I-T1M) TEACHER 2 (I-T2F) [Q: QUESTION; A: ANSWER; R= RESEARCHER] 13 OCTOBER 2016

Q:R **Did the workshop provide sufficient information regarding the Topnaars indigenous knowledge on water conservation to be included in the lesson?**

A: I-T1M: As this is only Grade 6 learners, the information was enough for their level of understanding. For me as a teacher it was also relevant as I had an idea what IK was but not how it can relate to science as I grew up in urban area and was taught the western way of science in school.

A: I-T2F: As a teacher I could relate to my upbringing in the village and incorporate it in the lesson, even the Grade 6 learners could relate to that. I now realise the value of my grandparents' upbringing in the village about conserving water.

Q:R Did the co-development of lessons benefit your presentation on the inclusion of indigenous knowledge into the topic water conservation?

A: I-TIM: Yes, I was more relaxed as I was part of the planning of the lesson and also know how to use the power point, projector and pointer.

A: I-T2F: Definitely, I felt confident and knowledgeable about the topic and knew how to use the interactive media such as the projector, pointer and slides.

Q:R Was the use of a Topnaar expert beneficial to the mediating of the topic water conservation using IK?

A: I-TIM: Yes, the expert brought a sense of cultural pride and identity back to the learners. His knowledge about his culture on how they have survived in the desert for hundreds of years made me realise how intelligent and much knowledge exist within the different Namibian culture groups. The fact that I could not go to the Topnaar community because of my school schedule made it easier for the leaners to grasps the importance of water conservation using IK because he did it very well.

A: I-T2F: Definitely because me and the learners could relate to our own culture. I felt very proud to be Oshiwambo as I could relate how my grandparents teaching us how to conserve water. He

talked with so much proudness about his culture and how their knowledge made them survive in the desert for hundreds of years. He was beneficial as I could not go physical to the Topnaars because of working conditions and time schedule of my school.

Q:R Do you think there is value in incorporating IK/local knowledge in our science curriculum after reviewing your lesson?

A: I-T1M: Yes, definitely. Namibia is a country with diverse ethnic groups. Different culture groups can each add value for example the different science topics. Walvis Bay is a multi-cultural town. Many learners were so proud to share their cultures experiences during the lesson. It will make the lessons fun.

A: I-T2F: Yes, coming from the north where I grew up in the village our culture has many IK as other Namibian cultures which can be of value to science teaching.

Q:R What are your views on the inclusion of IK during NSHE lessons in Grade 6 after observing your lesson, inputs from the expert and answers given by learners?

A: I-T1M: I think it will give value to our African culture as many learners growing up in urban areas are already losing their traditional values. It will give learners a sense of understanding, respect and appreciation for other learner's cultures and in the meantime enriching themselves with other cultures Indigenous Knowledge.

A: I-T2F: It will give a sense of pride to learners when they talk about the knowledge their elders possess. How they cured diseases using certain roots or leaves.

Q:R What factors do you think influence your views on the inclusion of IK during NSHE lessons in Grade 6 after looking at all aspects of your lesson presented?

A: I-T1M: Time and management members that are not sensitive to cultural issues. Currently our science curriculum does not include indigenous knowledge. We are driven by a scheme of work and syllabus which gives little time to include IK.

A: I-T2F: Time. Teachers have only 5 periods per week for science. IK is not included in the curriculum.

Q:R Reviewing your lesson now, what could be the reason why Grade 6 NSHE teachers do not integrate IK in their lessons?

A: I-T1M: We live in a society which are measured by results. Teachers are measured by their results. Teachers, therefore only focus on their syllabus to finish it and drill learners to pass their exams as all primary school are writing the same Natural Science paper.

A: I-T2F: Our syllabus and textbooks are written from a western perspective not having any views on IK.

Q:R What benefits could there be for including IK into NSHE lessons?

A: I-T1M: Indigenous Knowledge can help with local sustainability. Indigenous Knowledge and Western Science can be taught together as we have seen with our lesson presentation.

A: I-T2F: Integrating IK into Science Curriculum can save our planet and environment for the next generations. It can make lessons interesting. Learners can bring certain traditional resources when certain science topics are discussed

Q:R What was the response of the learners when IK/local knowledge was introduced in the lesson?

A: I-T1M: Learners find IK so interesting they talked about other forms of IK used by their elders in the village. Their questions and answers during the lesson as well as the answer given to question 3 indicated that they understood the value of IK.

A: I-T2F: Learners were exited and even asked questions not related to the topic on water conservation but related to other science topics. Their answer to question 3 and questions and answers during the lesson indicated they value Indigenous knowledge

APPENDIX G1 – LESSON OBSERVATION TRANSCRIPT: TEACHER 1MALE (O-T1M) (DOUBLE PERIOD) 12 OCTOBER 2016

The lesson was presented in the form of power point slides to guide teacher-learner interactions. The classroom interaction was mainly a discussion between the learners and the teacher. The teacher often posed well-structured questions of higher cognitive demand. Clarity was then sought by posing follow-up questions.

This lesson (double period) was only on the topic water conservation with the inclusion of indigenous knowledge of the Topnaar people. The lesson started with the teacher giving the objectives of the lesson. He said:

"we are going to do the section in your syllabus on water conservation – And we are going to start off with this picture. (Teacher puts on power point slides and shows the picture of the objectives and competencies to be achieved as set out by the syllabus)".

The purpose was to prepare the learners for what was expected from them in this particular topic and connecting this with Indigenous knowledge/local knowledge from the Topnaar community.

T: Shows a picture of the desert which shows the scarcity of water. He explains that the plants in the picture are scattered and not clustered. He asked the learners why they think there are plants there although it is dry.

The teacher used the slide in Figure 5.2.1 (a) to support learners' understanding of the dry conditions the Topnaar community lived in as scaffolding learner's prior everyday knowledge. This was evident in the way they answered the questions. They responded as follows:

L: Because they have adapted to live in dry conditions.

T: Can anyone give me some features of plants that have adapted to live in dry conditions.

L: They store water, they grow rapidly, and they have thorns to reduce transpiration.

T: Can you give me the names of desert plants that have adapted to live in dry conditions?

L: !Nara and welwitschia plant and camelthorn.

T: Introduce local Topnaar community to explain how they conserve water in the desert.

The use of the Topnaar expert was decided by the teachers during their co-development of lessons as it was impossible for them to go with the researcher to conduct interviews.

TN: Asked learners if anyone know the Topnaar community or have they been in that area.

L: Somewhere in the desert.

TN: Topnaars regards water as sacred, will save it and will always make sure that the next person have access to water. Shows pictures of Camelthorn trees growing in the riverbed which produce pods. The pods is a food source for the goats/small livestock. Shows that the !Nara is the most important of all as it is consumed as whole by the Topnaars and animals. Also shows the roots which has medicinal value. Stresses the value of water for the growth of the !Nara plant and trees. Shows donkey cards as a transport to collect and distribute water as well as the importance of the containers to store water.

The expert showed learners the spirit of Ubuntu (kindness, caring, neighbourly) when "*will always make sure that the next person have access to water.*" As this is one of the traits that is lost in our society today.

TN: How do you in town drink your water?

L: From the taps or from the water bottles we bring to school.

TN: Why do you think they have to store water?

L: So they can use it again.

L: It is far to collect water.

L: Water is not regularly available.

The Topnaar expert clearly wanted to connect to the learners' prior knowledge

TN: NAMWATER extract water. Mines need clean. NAMWATER supplies water to towns, fishing factories and mines. Explains how water gets to the coast from the highlands of central Namibia. Water sinks in the dry riverbeds. Heavy extraction of NAMWATER makes it impossible for Topnaars and plants to get to water source underground. This causes a problem for the Topnaars

as the trees and !Nara plants cannot grow meaning no food source for the goats. Shows picture of small containers.

TN: Think about how much water do you use at home per day? Do you really need 80liters to bath in?

LLL: No.

TN: Topnaars use small container to wash and res-use water by pouring it under trees or under extreme cases like the drought currently they will use the water to wash their clothes.

The Topnaar expert shows the importance of containers to collect, save and measure water consumption.

TN: Do you know how water get to your tap?

LLL: No

TN: Explains the process of how expensive it is to get water to the houses and school so that you just open the tap. Topnaars realised long ago the importance of saving water for them to survive for their children and children to come so they can also benefit from the Kuiseb River. That is why they will use a 20 liter for a week.

L: How did their forefathers store water?

TN: Ostrich eggs, put piece wood in the opening and place under tree with a marker to keep cool. They could not carry water around in the desert. Leaves water under trees not for themselves but for somebody else. People move up and down in the desert and they know where to find water as a marker was placed at the spot where the water was. Later they made clay pots to store water in.

T: Shows learners a video clip about rain falling in central Namibia and how it comes down through the desert to the coastal town. The clip also indicates the importance of this rain water for the Topnaars their livestock, the !Nara plants and trees growing in the desert.

Shows clip with images on how water is wasted in their local community. Explains the images to the learners instead of asking learners to identify how water is wasted.

L: Explains that she observes in one of the pictures also how water is wasted by bathing.

T: Is there any water conservation practices at our school?

LLL: Report leaking taps. Make sure water taps are closed.

T: Water conservation is everyone's business. Can someone explains how the water cycle works?

L: Evaporation, water move to clouds, clouds get heavy rain falls and it moves from the highlands to the coast.

Teacher 1 gave the learners an opportunity to work in groups and discuss what they have learned and in the same time see if his mediation on the topic water conservation using indigenous knowledge from the Topnaar community was understood.

T: Three questions. Learners do group work to answer these questions.

a) WHY DO WE NEED TO CONSERVE WATER?

b) HOW CAN WE CONSERVE WATER AT SCHOOL AND AT HOME?

c) WHAT CAN WE LEARN FROM THE TOPNAARS LOCAL KNOWLEDGE WHEN IT COMES TO CONSERVING WATER?

Question three was of utmost importance to see whether learners understood the indigenous knowledge possessed by the Topnaars. See attached answers of learners in School A.

a) They need water for trees to grow, for the pods.
b) They store water in the case pf drought.
c) The !Nara plant need water from underground. !Nara produce medicine.
d) Every living thing in the desert feeds on the !Nara.
e) They use a lot of water containers to store water.
f) Reuse water.
g) Don't leave taps running think of the next person who needs water.
h) Conserving water is important.
i) Measure usage of water on a daily basis

APPENDIX G2 – LESSON OBSERVATION TRANSCRIPT: TEACHER 2 (FEMALE) (O-T2F) (DOUBLE PERIOD) 11 OCTOBER 2016

The teacher first greeted the learners before commencing with the lesson. The lesson was introduced by the teacher saying: *"I am going to talk about the importance of water conservation basing our topic on indigenous knowledge (IK). Knowledge that has been passed on by our forefathers and I am going to concentrate more on the Topnaar people who lives in the desert. (*This immediately gave learners an understanding what indigenous knowledge was). *You know that Namibia is a dry country which receive low rainfall. She immediately relates to the current drought experienced by the country and why it is so important to conserve water. She then gives the objectives of the lesson and competencies as set out by the Natural Science syllabus.*

The purpose was to prepare the learners for what was expected from them in this particular topic and connecting this with their prior every day knowledge. The teacher used an interesting approach to prevent the topic from being isolated from other topics using the Levels of Organisation as elicitation of prior knowledge. She then shows the picture of the desert asking leaners to identify what they see, which was a different approach than teacher 1. Teacher 1 was telling learners what the picture explains where as teachers 2 were asking the learners to explain the picture.

T: Shows picture and ask learners to identify the picture.

LLL: The desert

T: Can you see how scattered the trees are and how dry it is? Can you see the Topnaar people living there?

LLL: Yes

T: Shows picture of me and Topnaar community member who went to investigate their water practices.

This was to make learners understand that there are people within their community who possess local indigenous knowledge on how to conserve water. The teachers and I hoped to develop a better understanding of the role of indigenous knowledge in science teaching especially the topic water conservation.

T: Shows picture on the power point slide of the resources the Topnaar community rely on. What type of tree do you see? Instead of explaining she rather asked the learners to identify to see what prior knowledge they have.

L: Nara Tree

T: No, it's a camel thorn tree.

T: She explains the pods on the trees and the value to the small livestock. As well as the fleshy part of !Nara melon that can be eaten as it contains water. She explains the root that contains water which is drank by people as a means of medicine and supplementing water. Explain the donkey card with containers to deliver water and that the Topnaar household live from 20 liters or less water per day.

The teacher again made effective use of power point slides on the screen to explain the Topnaars reliance on water. The reason was to give ample time on elicitation of prior knowledge as seen below. This took place mainly in the form of the question-answer method as well as active participation through discussion between teacher and learners. The teacher posed well sequenced questions, guiding to a better level of understanding. There was a good poise between teacher and learner talk.

T: Where do you get water from? The water that comes from your taps. Anna

L: NAMWATER

T: Where does NAMWATER get their water from?

L: From underground.

T: Explain how water gets to the coast through rainfall on the highlands in central Namibia. NAMWATER drill and the Topnaars suffer as the trees and Nara cannot reach the water table underground. No water for the livestock and Nara to grow on which they depend.

T: Shows a video of rainfall in and how the water gets through the desert.

The video was coinciding with figure 5.2.2 (c) to give learners a perspective that if there is drought in central Namibia, there will not be any flow of water to the coastal area which affects the Topnaars livelihood like their goats, !Nara harvesting and the Topnaars themselves.

T: Show image of water being wasted? Is water used wisely at our school?

LLL: No

T: How is it wasted?

L: Taps are Left open. Cleaner's washing windows with hosepipe. Children play with water. Don't use cups to drink water.

T: Look at pictures and identify ways how water is wasted.

L: Taps leaking. Bath instead of shower. Brush teeth leaving tap running. Wash car with pipe instead of bucket. Illegal car washes.

T: How many illegal car washes in Walvis Bay.

LLL: Hundreds.

T: How can we safe water using the knowledge from the village which your grandparents showed you? I want to hear from people from the north. Don't think of the western way.

L: Use the same bath water all boys and girls.

L: Wash hands in container everyone. After eating they use the same water to wash hands.

Connecting learners to prior knowledge (discussed in section 2.5) and indigenous knowledge (discussed in section 2.6.2) in the villages on how to conserve water. Answers given above shows peer interaction and reasoning, with the teacher controlling these interactions with well sequenced questioning creating a collaborative ZDP as discussed in Section 2.7.1. This also link up with learners' centred approach discussed in Section 2.3 where learners are active participants.

T: Introduction of Topnaar expert to talk about their water practices.

Teacher 2 introduced the Topnaar expert later in the lesson whereas Teacher 1 introduced him early in the lesson, as she thought of trying another teaching approach.

TN: How many of you know about people living in the desert?

LLL: No response.

TN: If you in town or at school when you thirsty you just go to tap. Topnaars confined to the environment with no taps. Industries have caused water to get scarce in the desert. NAMWATER biggest of scarcity. Ancestors dug hole in desert half a meter and scoop water with wood or clay to get water. Nowadays impossible because water levels dropped. Plastic containers important nowadays to store water as there are only certain water points.

TN: How much water do u need to bath?

L: 50Liters

TN: Showing images of containers. Topnaar use a small container to wash themselves.

TN: Water is not about themselves but the next person. That is why they save water. Water was traditionally stored in eggs. Use what nature provided. Will know where to find water as it is placed under trees for the next person. Clay pots were also made to store water. Animals are given water in small containers to save water. They only wash once a day in a small container.

The expert showed learners the spirit of Ubuntu, Chapter4: 4.3.1 (kindness, caring, neighbourly), with the statement "*Water is not about themselves but the next person.*" This is one of the traits that is lost in our society today.

L: How is NAMWATER extracting water and how does it influence the Topnaar.

TN: Water is extracted to supply the mines, industries and households. The water levels drop and the trees and Nara plant cannot get water. If the trees don't have water they cannot produce pods for our livestock. If the Nara plant cannot grow we will not have melons as our staple food and the peels for our livestock. All animals need the Nara melons as it is a water source. The roots have medicinal value.

T: Teacher 2 gave the learners an opportunity to work in groups and discuss what they have learned and in the same time see if her mediation on the topic water conservation using indigenous knowledge from the Topnaar community was understood.

The lesson concluded with a group activity as shown in the questions below.

a) WHY DO WE NEED TO CONSERVE WATER?

b) HOW CAN WE CONSERVE WATER AT SCHOOL AND AT HOME?

c) WHAT CAN WE LEARN FROM THE TOPNAARS LOCAL KNOWLEDGE WHEN IT COMES TO CONSERVING WATER?

Question three was of utmost importance to see whether learners understood the indigenous knowledge possessed by the Topnaars. See attached answers of learners in School B.

a) Because they are not educated but knows how to save water.
b) We learn they use 20 liters of water per week.
c) They walk 300 meters to collect water.
d) They collect water by carrying them in a donkey cart.
e) Never waste water.

Appendix 4: Lesson Observation Tool

LESSON OBSERVATION TOOL

Content: Extent to which Science Content of lessons reflects each of the following

	Not at all	To a great extent
Teacher-provided prior content information was accurate		
The IK content was significant and worthwhile		
The teacher displayed an understanding of science and IK concepts (e.g., in his/her dialogue with students)		
The science/IK content was appropriate for the developmental needs of the students in this class		
Appropriate connections were made to other areas of science, to other disciplines, and/or to real-world contexts		
Students were intellectually engaged with important ideas (IK) relevant to the focus of the lesson.		
The degree of 'sense-making' of science/IK content within this lesson was appropriate for the developmental levels/needs of the students and the purposes of the lesson		
Interactions reflected collaborative working relationships between teacher and students		
Interactions reflected collegial working relationships among students (e.g., students worked together, talked with each other about the lesson)		
The teacher's questioning strategies were likely to enhance the development of student conceptual understanding		

Appendix 5: SAT's Results

Republic of Namibia

MINISTRY OF EDUCATION

DIRECTORATE OF NATIONAL EXAMINATIONS AND ASSESSMENTS

Report on the National Standardized Achievement Test (NSAT), 2015

Grade 7 Science

School Demographic Information:

School Code:	**!132**	School Name:	**!NARA PS**
Rural/Urban:	**Rural**	Region:	**Erongo**
No. of Learners Taking the Test:	**55**		

Overall Performance Comparison (in percentage score):

	Baseline (2010)	Follow up (2015)	Change (2015-2010)
National	0	59	0
Region	0	65	0
School	0	65	0

Performance Level Category Comparison (in percentage of learners):

		Below Basic Achievement	Basic Achievement	Above Basic Achievement	Excellent Achievement
National	2010	0	0	0	0
	2015	4	45	38	13
Region	2010	0	0	0	0
	2015	3	29	44	24
School	2010	0	0	0	0
	2015	0	27	58	15

Below Basic Achievement: The learner demonstrates **insufficient** knowledge and skills across all themes in the syllabus.

Basic Achievement: The learner demonstrates **sufficient** knowledge and **limited** skills across all themes in the syllabus.

Above Basic Achievement: The learner demonstrates **proficient** knowledge and skills across all themes in the syllabus.

Excellent Achievement: The learner demonstrates **excellent** knowledge and **advanced** skills across all themes in the syllabus.

Republic of Namibia

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Report on the National Standardized Achievement Test (NSAT), 2015

Grade 7 Science

School Demographic Information:

School Code:	**I132**	School Name:	**!NARA PS**
Rural/Urban:	**Rural**	Region:	**Erongo**
No. of Learners Taking the Test:	**55**		

	Cognitive Level	National	Regional	School
Describe the energy flow through living organisms within the chosen local environment	Comprehension	62	68	53
Topic: Storage and conservation of water		48	57	55
Explain the importance of conserving water	Application	48	57	55
Topic: Air pollution		42	51	44
Distinguish between human-made and natural air pollution	Comprehension	43	51	45
Name controls and regulations against air pollution	Knowledge	41	50	42
THEME 3: Matter, Light and Energy: Matter, Forces and energy, and Light		46	51	50
Topic: Nature of matter		50	64	67
Describe different properties of substances	Knowledge	43	59	65
Name the three states of matter	Knowledge	55	67	69
Topic: Building blocks of matter: atoms and molecules		49	58	56
State that atoms are the smallest building blocks of matter	Knowledge	61	65	56
Classify elements into metals and non-metals	Application	41	59	73
State that every element has a name and a symbol	Knowledge	41	39	23
Topic: Building blocks of matter: elements and compounds		36	40	35