

**PRESENTATION AND REPRESENTATION OF ENVIRONMENTAL PROBLEMS
AND PROBLEM-SOLVING METHODS AND PROCESSES IN THE GRADE 10
GEOGRAPHY SYLLABUS: A NAMIBIAN CASE STUDY**

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ABSTRACT

Environmental issues in Namibia are considered to be one of the major threats to the lives of the Namibian people (Namibia. Ministry of National Planning Commission [MNPC], 2004). This study explored problem solving as one of the teaching methods used in Grade 10 Geography syllabuses as a response to such environmental issues/risks. Geography provides learners with an understanding of the issues and risks in their world that need to be addressed in order to improve the quality of their lives and health of their environment.

This study focused on how environmental problems and problem-solving methods are presented in the Namibian Grade 10 Geography syllabus and how these are represented and implemented through teacher intentionality and practice. The theoretical framework for this study was informed by two theories namely risk society and social constructivism.

This study was conducted at three schools in the Rundu circuit in the Kavango region and one teacher was involved in the study at each school. This study was conducted within an interpretive research tradition and was qualitative in nature. The study used document analysis, focus group discussion and classroom observation as data generation methods.

The findings of the study reveal that the complexity of environmental issues is highlighted in the syllabus and in teachers' intentionality and practice. The findings also show that a limited variety of teaching methods were used in problem solving strategies. The study also found that problem solving was influenced by different constructivist learning principles. The study further found that limited numbers of problem-solving steps were used in the process of problem solving.

The study concludes by calling for further research into problem solving strategies. This can be done to empower Geography teachers to use more complex problem solving strategies to deepen problem solving and to engage problems in more depth.

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LIST OF ACRONYMS

EPA	Environmental Protection Agency
ESD	Environmental for Sustainable Development
HIV/AIDS	Human Immunodeficiency Virus/Acquire Immune Deficiency Syndrome
IUCN	International Union for the Conservation of Nature and Natural Resources
MDG	Millennium Development Goal
MoE	Ministry of Education
NDP	National Developmental Plan

NEEN	Namibia Environmental Education Network
NGO	Non-Governmental Organisation
SEEN	Supporting Environmental Education in Namibia
UN	United Nations
UNDESD	United Nations Decade of Education for Sustainable Development
UNEP	United Nations Environmental Programme
UNESCO	United Nations Education, Scientific and Cultural Organisation
WSSD	World Summit on Sustainable Development
WWF	World Wildlife Fund for Nature
ZPD	Zone of Proximal Development

CHAPTER 1: OVERVIEW OF THE STUDY

1.1 Introduction

This study explores problem solving as one of the teaching methods used in the Namibian Grade 10 Geography syllabus as a response to environmental problems. The study takes place in three schools in Rundu of the Kavango region in Namibia. This chapter covers the background to the study as well as a brief introduction to the study context. The chapter then presents the rationale for this study. The research question and goals are introduced. Finally, the chapter concludes with an overview of the research chapters.

1.2 Background to the study

In this study I worked with three Grade 10 Geography teachers of the Rundu circuit in Namibia. For the past seven years I have been working as a Geography teacher at Ruuga combined school which is part of this circuit. This study focused on how environmental problems and problem-solving methods are presented in the Namibian Grade 10 Geography syllabus and how these are represented and implemented through teacher intentionality and practice. In the past seven years of teaching Geography in Grade 10 at a combined school, I have been faced with the challenge of using problem-solving teaching methods. In order to develop a comprehensive research focus for my studies I conducted a contextual profile. This research revealed that some of the challenges experienced by the subject advisor and the teachers I work with were similar to these that I am facing (Zokka, 2011). According to the subject advisor for Geography and two teachers that participated in this study, they also found it difficult to understand how environmental problems are represented and how to use problem-solving methods when teaching environmental issues in Geography (*ibid*). Research in environmental learning in southern African has identified a number of challenges of possible significance in teaching environmental learning. Lotz-Sisitka, Olvitt, Gumede & Pesanayi (2006) state that many southern African countries have a problem in teaching environmental learning in their mainstream curriculum. They mentioned that these challenges include a negative perception toward environmental learning as extra-curricular, lack of team work between teachers from different subjects, teachers' lack of adequate knowledge, commitment and time to work with environmental issues, and the negative

influence of school principals that sometimes prohibit teachers from practicing environmental learning in schools (*ibid*). In Namibia, Imene (1999) states that the challenges of teaching environmental learning in Namibian schools are; resistance to change from the teachers, school management and parents, lack of understanding of environmental issues and their impacts on human and nature, and teachers' lack of knowledge and poor understanding of a learner-centred approach to teaching.

1.3 Brief introduction to the context of the study

Environmental issues in Namibia are considered to be one of the major problems causing a serious threat to the lives of the Namibian people, animals and plants (Namibia. MNPC, 2004). Ruppel & Ruppel-Schlichting (2011) say that the environmental issues that Namibia is experiencing were inherited at independence on 21 March 1990. These environmental problems mentioned by Ruppel & Ruppel-Schlichting (*ibid*) include land degradation, destruction of woodland areas, desertification, population growth, rural land use conflicts, pollution, urban land use conflicts, water and declining fish resources, declining of wildlife, overstocking, overgrazing and bush encroachment.

Namibia faces environmental problems that are a challenge to the future development of the country. Thus, Namibia developed responses to these environmental problems through formal and non-formal education (Imasiku, 1999; Imene, 1999). One of the main educational steps taken to respond to these environmental problems in Namibia was the incorporation of environmental education into the formal education curriculum of 1996-2006. According to Enviroteach (1995, p 3) “environmental education is acknowledged as one of the options that can be used to respond to environmental problems because it empowers people to take a leading role in solving environmental problems and ensuring sustainable living”.

After independence, the integration of environmental education in the education curriculum started in some subjects such as Life Science and Geography (Enviroteach, 1998; see also Imene, 1999). Enviroteach (1998) further says that the teaching of environmental education specifically in Geography emphasised knowledge about the beauty of our environment in a way that separated human beings from environment. Imasiku (1999) explains that the integration of

environmental education in some sections in Life Science and Geography did not support teaching methods that focused on developing learners' skills such as critical thinking and problem solving skills to address environmental issues. Imasiku (*ibid*) also observes that Geography and Life Science teachers were not familiar with some teaching methods such as group work, project work and problem solving, which were encouraged by educational reform in 1993 (Ministry of Education and Culture, 1993).

According to Imene (1999) the Namibian curriculum 1990-2006 provided opportunities for active learning which promotes skills such as critical thinking and problem solving in teaching and learning processes. In response the Namibia Environmental Education Network (NEEN) developed an Environmental Education Policy for Namibia in 1999. The aim of this policy was to serve as a guide for the inclusion of environmental education in formal and non-formal education in Namibia to address environmental problems. The Environmental Education Policy for Namibia declared a number of fundamental goals for environmental education in the Namibian curriculum. These goals are serving as a yardstick in teaching problem solving methods in environmental education learning activities in many subjects including Geography. This is particularly in relation to the Ecology topic specified in the Grade 10 curriculum where learners are expected to use "simple project reports to facilitate the understanding and action taking/problem solving of environmental risks and issues" (Murray, 2005, p. 3).

This study will focus particularly on teachers' knowledge of environmental issues (how they are perceived) and their use of problem solving as a particular learner-centred approach to teaching.

1.4 Motivation for the study

The problem solving method is reported, as among the less commonly used teaching methods, in teaching environmental education in core subjects because it requires a lot of preparation from the teachers (SEEN, 2005). This is not only found to be a challenge amongst Namibian teachers. Fien (1993) observes that problem solving method in teaching environmental education are difficult to implement. He further says that the problem solving method is essential in teaching environmental problems, because it encourages learners to believe that they can play a role in solving environmental problems.

Murray, in *The National Environmental Learning Curriculum Guidelines for Educators*, states that Namibians should integrate environmental learning in schools to engage learners in enquiry-based learning that is based on problem solving methods (2005). He further states that problem-solving methods will develop learners' vision to use and manage their resources for the benefit of all (*ibid*, 2005). Murray observes that the local environment can be used to promote environmental learning in Geography, noting that: "this can be encouraged by investigating local issues, through exploring environmental issues to identify the challenges [learners] see around them and then to carry out a mini-research project into one of them" (Murray, 2005 p. 55). He further says that this will help learners to take action by exploring how environmental issues are rarely simple and often have more than one solution.

A concern with the implementation of teaching methods is raised in two recent Namibian research studies, on how environmental education promotes action taking activities in Geography (Simasiku, 2011) and Biology (Tshiningayamwe, 2011). Simasiku's study was about the implementation of enquiry-based learning in Grade 11-12 Geography to facilitate action competence, while Tshiningayamwe's study was about the enabling and constraining factors that influence the implementation of environmental education in the Biology syllabus. Simasiku's study found out that Geography teachers lack practical knowledge of teaching fieldwork skills and research techniques to learners. Such knowledge and techniques are fundamental to promote problem solving skills. His study also indicates that some teachers are not familiar with how to integrate environmental learning into the Geography curriculum. Tshiningayamwe's study found out that science teachers lack understanding as to how to implement environmental education, thus resulting in a low status regarding environmental learning activities in science. Her study also revealed that the development of critical thinking and problem solving among learners is failing because of inadequate support from education authorities for the implementation of environmental learning in science. In her research, she concluded that teachers have little understanding on how to implement teaching methods such as problem solving methods. This previous research suggests the importance of research that makes a contribution toward knowledge about teaching environmental education using problem solving teaching methods.

1.5 Research Question and goals

This study was designed to answer the following question: How are environmental problems and problem-solving methods and processes presented in the Namibian Grade 10 Geography syllabus and how are these represented through teacher intentionality and practice?

In order to answer this research question, three goals were formulated, namely:

- **Goal 1** To describe the presentation and representation of environmental problems in the Geography Grade 10 syllabus, teacher intentionality and teacher practice.
- **Goal 2** To describe the presentation and representation of problem solving teaching methods in the Geography Grade 10 syllabus, teacher intentionality and teacher practice.
- **Goal 3** To describe the presentation and representation of problem solving processes in the Geography Grade 10 syllabus, teacher intentionality and teachers in practice.

Thus the first part of each goal is concerned with curriculum as it is presented in the syllabus, while the second part of each goal (focusing on teacher intentionality and teacher practice) is concerned with curriculum as interpreted and implemented by teachers in practice. This perspective on curriculum is informed by Cornbleth's (1990) view of curriculum as not only a static document, but also as a process arising in specific contexts.

1.6 Overview of the thesis chapters

There are five chapters following this introductory chapter. Each chapter is an explanation of a particular stage in the development and implementation of the study process.

Chapter 2 discusses environmental problems in the Namibian context. It also discusses significant events in international conventions. It further discusses problem-solving in teaching and problem solving teaching methods in Geography education more specifically. The chapter then describes environmental problems and problem solving in the Namibian Geography syllabus. Furthermore, the chapter explores the understanding of the term environmental problems in environmental education using Beck's (1992) description of risk society. Finally, the chapter concludes by discussing problem solving and its relation to social constructivist learning theory.

Chapter 3 explains the methodology applied in the study, and the associated research design decisions and research processes. It provides details on methods of data generation (document analysis, focus group discussion and classroom observation). The chapter also explains how the data were analysed and interpreted. Finally, the chapter discusses issues of validity and ethical considerations within the study.

Chapter 4 is a presentation of the data. It contains the summary and presentation of the lessons of environmental problems and implementation of problem solving teaching methods in the Grade 10 Geography syllabus. The chapter also provides a detailed cross-cases description of environmental problems and problem solving which was generated from document analysis, focus group discussion and classroom observation. The chapter further presents an analysis of problem solving learning processes by using an amalgamated problem-solving learning model as a comparative tool.

Chapter 5 discusses the research findings in relation to the literature review in Chapter 2. The discussion is presented as a set of analytical statements.

Chapter 6 summarises the key findings that arose from of the study. The chapter also provides a summary of the study, recommendations arising from the study, and recommendations for further research.

CHAPTER 2: KEY IDEAS INFORMING THE STUDY

2.1 Introduction

This chapter reviews literature relevant to the teaching of environmental education in the Grade 10 Geography syllabus with emphasis on environmental problems and problem solving. The review starts by discussing environmental problems in the Namibian context. Thereafter, the chapter explores significant events in international conventions. The chapter also reviews problem solving in teaching and problem solving teaching methods in Geography education specifically. It further reviews the presentation of environmental problems and problem solving in the Namibia Geography syllabus. To provide a theoretical perspective on environmental problems the chapter reviews the notion of environmental problems drawing on Beck's (1992) thesis of risk society. Furthermore, the chapter discusses environmental problem solving as a teaching method. Finally, to provide further depth to the discussion of problem solving, the chapter considers Vygotsky's socio-cultural theory of learning, which can help to explain how teachers work in cooperation with learners to solve problems.

2.2 Environmental problems in the Namibian context

Since independence in 1990, the Namibian Government has given high priority to identifying environmental concerns which pose a threat to the future development of the country (Imene, 1999). According to the Ministry of Education's *Vision 2030* the realization of environmental issues in education was an important step in addressing environmental issues in Namibia (MoE, 2009). This was an educational response to Article 95 of the Namibian Constitution which maintains that:

The state shall actively promote and maintain the welfare of the people by adopting, inter alia, policies aimed at ... maintenance of ecosystems, essential ecological processes and biological diversity of Namibia; utilization of living natural resources on a sustainable basis for the benefit of all Namibians, both present and future. In particular the government shall provide measures against the dumping or recycling of foreign nuclear and toxic waste on Namibia territory.

Imene (1993, p.3)

The government identified the importance of amending all national policies to address environmental challenges facing the country. These included Namibian policy documents such as the Constitution of 1990, the First and Second National Developmental Plan (NDP) of 1990 and 1992 respectively and the Green Plan of 1992. These documents highlight that many Namibians depend heavily on natural resources and this puts the natural environment at risk of degradation (Murray, 2005). According to Murray (*ibid*) Namibia has 12 inter-linked environmental issues that pose a major threat to the environment and development. These are listed in Table 2.1 below.

Table 2.1 Inter-linked environmental issues that pose a major threat to environment and development (Murray, 2005)

Environmental problems/challenges	Environmental links
Economic growth and industrialisation	Over-exploitation of the limited and fragile renewable natural resources base is degrading it.
Poverty and inequality	Poverty reinforces environmental degradation. Gender inequality hinders the sound management of resources.
Water: Access and supply	There is insufficient water for people, wildlife and industry. Existing policy of water management is inefficient and unsuitable. Poor or less powerful people have less access to water.
Land: Carrying capacity and tenure	Most land can support many people, but it is unfairly distribute. Policies and actions between different sectors over land lack harmonisation.
Biodiversity conservation	Increase human pressure on ecosystems causes genetic erosion at all levels (species, ecosystem and sector). Regular access and promoting the equitable sharing of benefits is problematic.
Population growth and settlement patterns	Too many people are sharing limited resources, particularly in certain areas. Urbanization has resulted in health and social problems.

Human resources	There are insufficient human resources for development. HIV/AIDS is harming families and livelihoods, reducing national economic prosperity and opportunities for sustainable development.
Governance	Human rights, democracy, peace and security need safeguarding. Namibia lacks a pro-active and articulate civil society. Resources management requires decentralising and devolving.
Economic policy and management	Namibia lacks of suitable macro-economic environment to foster investment and job creation.
Regionally and globally shared natural resources	There is increase competition for trans-boundary resources such as shared rivers, wetlands and marine fisheries. Global warming and ozone depletion could seriously damage Namibia.
Knowledge for sustainable development	Existing knowledge is not accessible, shared widely or managed well.
Culture, communication, attitudes and lifestyles	Sustainable development is best implemented through a shared vision and core values. The lack of inter-communication and understanding among different cultural, social and economic groups hampers the drive for equality and quality for all.

This table can be used as resource for Geography teachers focusing on problem-solving in the Geography curriculum as it outlines the scope of environment problems in Namibia. In this thesis this table was used in order to review the scope of the problems focused on by teachers in the cases analysed.

To understand better the complexity of environmental problems in Namibia, Murray (2005) described four dimensions of environmental issues in Namibia which are; biophysical (nature provides living resources and life support systems); social (how and where people live changes the environment); economic (resource use provides jobs money and has an impact on the environment) and political (who decides how resources are used) (See also MoE, 2009).

Namibia's environmental problems are complex and have negative impacts on our quality of life now and in the future. Traditionally, the understanding of environment in Namibia was only focused on the beauty of nature, but now environment is broadly understood to mean nature and people (Murray, 2005; MoE, 2009). With integration of environmental learning in the national curriculum Namibians have realised that "environmental challenges and issues are not biophysical problems to be studied as part of nature, but are also related to and caused by social, economic and political factors" as well (Murray, 2005, p. 6). These environmental challenges and issues which manifest in socio-ecological spheres of society are elaborated below.

Murray (2005) explains that Namibia's soil continues to blow off the land and wash down the rivers, leaving the land increasingly degraded and everyone poorer. Moreover, he says that overgrazing and tree cutting in areas of marginal agricultural activity threaten habitat and wildlife. Off the coast, overfishing by commercial interests continues to erode traditional Namibian livelihoods. He further points out that as a result of an increasing population; poverty, poor facilities and unemployment are on the increase and these force people to migrate into overcrowded informal settlements on the fringes of towns. He elaborates by pointing out that lack of clean water and proper toilets makes it difficult for people to stay healthy in an environment that is impacted by related social, economic and environmental issues such as poverty, HIV infections and drought. Murray (2005) asserts that death from HIV/AIDS, which is continuing to rise, places ever-increasing stress on the resources of families, communities and the nation. He adds that the water usage is inefficient and inequitable, and the productivity of the land continues to be held back by inappropriate land distribution, tenure and use (*ibid*). These environmental challenges affecting Namibians are jeopardising the future for a healthy environment and prosperity of Namibian citizens (Murray, 2005, see also MoE, 2009).

Ruppel & Ruppel-Schlichting (2011) argue that Namibia experiences environmental problems comparable to many parts of Africa. Some of the common issues include unsustainable harvesting of wild plants and wildlife, land degradation and soil erosion, deforestation, water management, climate change, waste, social injustice and inequity as well as risk faced from globalisation.

2.3 Significant events in international conventions

The development of the concept of environmental problems has a long history. According to Lotz-Sisitka, et al. (2006) the concept of environmental problems has received much attention nationally, regionally and globally by many countries. From an international point of view the establishment of the United Nations Education, Scientific Cultural Organisation (UNESCO) in 1946 was a cornerstone in bringing the concept of environmental problems to the attention of the United Nations (UN) (Irwin & Lotz-Sisitka, 2004). This was influenced by environmental issues that started to cause concern following the industrial revolution. These concerns included resource depletion, air pollution, waste production and toxin mismanagement (*ibid*). Irwin & Lotz-Sisitka explain further that two years later the International Union for the Conservation of Nature and Natural Resources (IUCN) as a scientific body raised concerns regarding the world's diminishing natural resources, including wildlife (*ibid*). Added to this in 1961 the world saw the formation of the World Wildlife Fund (WWF). Both bodies (IUCN and WWF) noted that many human activities were causing harm to the environment. According to UNESCO (1988) such human-linked environmental problems included pollution in water, air and land; undesirable disturbance to the ecological balance of the biosphere; destruction and depletion of resources; desertification and deforestation. According to Irwin & Lotz-Sisitka (2004) UNEP and UNESCO, at an international workshop Belgrade, Yugoslavia in 1975, stressed the effects of environmental problems and called for environmental education to be integrated in all levels of education as a response to environmental concerns. These bodies started to persuade governments, educational institutions and NGOs to include environmental awareness in order to deal with environmental problems (UNESCO, 1988). UNESCO (*ibid*) further states that UNEP and UNESCO called for the development of environmental education to help individuals and social groups to acquire skills for solving environmental problems.

Following the Belgrade workshop was an intergovernmental conference on environmental education in Tbilisi, 1977, that resulted in the declaration of 12 principles of Environmental Education, to guide the practice of environmental education on a global, regional and national scale (Irwin & Lotz-Sisitka, 2004; Lotz-Sisitka, 2007). According to UNESCO (1988) environmental education was described at Tbilisi as a “permanent process in which individuals

and community gain awareness of the environment and acquire the knowledge, value, skills, experiences and also determination which will enable them to act to solve present and future environmental problems” (p. 6).

One of the earlier criticisms of environmental education was that, it had not taken a position to include social, economic and political systems in its discussion on the root causes for environmental problems (Fien, 1993). Lotz-Sisitka (2004) reports that the UN organised the Earth Summit in 1992 in Rio de Janeiro to address the urgent problems of environmental protection and socio-economic development. She adds that one of the main roles of the Rio Earth Summit was educational responses to the environmental crisis. Irwin & Lotz-Sisitka, (2004, p. 43) reiterate that The Rio Earth Summit also places “emphasis on understanding the systemic nature of crises that threaten the world’s future and notes that the root causes of environmental issues such as poverty are closely linked to the dominant socio-economic system”.

The main document which came out of the 1992 Rio Earth Summit was *Agenda 21* which outlines actions for nations to achieve sustainable development in the 21st century (United Nations, 1992). According to the United Nations (*ibid*) Chapter 36 of Agenda 21 encourages countries to be involved in promoting environmental education within their own context and reorienting education towards sustainable development. According to Lotz-Sisitka (2004) Agenda 21 was a pillar of environmental education in formal education, because it tasked nations to involve both teachers and learners in promoting sustainable development to address environmental issues (see also Irwin & Lotz-Sisitka, 2004; Lotz-Sisitka et al, 2006). Lotz-Sisitka et al (2006) assert that many significant developments followed the Rio Earth Summit to strengthen environmental education in southern Africa as well as in Namibia; notably: The Millennium Development Goals (MDG) (World Bank, 2000), The World Summit on Sustainable Development (WSSD) (2002) and the UN Decade for Sustainable Development (UNDESD) (2005). They further report that these conventions were all aimed at addressing environmental issues such as poverty, hunger, environmental instability, child mortality, poor education and diseases which affect the global village. Lotz-Sisitka (2004) reports that the major environmental problems deliberated during WSSD were sanitation, energy, trade, human rights, biodiversity loss and climate change. She further points out that the role of environmental education was once

again emphasised during the World Summit on Sustainable Development, as a response to socio-ecological, political and economic issues at the global level (*ibid*). Having highlighted the representation of environmental problems in the international context, the next section follows with an exploration of a particular pedagogical response to the widespread and complex issues – that is, problem-solving.

2.4 Problem solving in teaching

For much of the 20th century, educators have devoted their attention to trying to define and teach problem solving skills (Kirkley, 2003). In the early 1900s, problem solving was viewed as a mechanical, systematic, and often abstract (decontextualized) set of skills, such as those used to solve riddles or mathematical equations (*ibid*). These problems often have correct answers that are based on logical solutions with a single correct answer (convergent reasoning) (*ibid*). Problem solving teaching has been addressed by authors such as Adeyemi (2008, p. 698) who says that “problem solving involves taking a series of actions in the process of an investigation that seeks to bridge the gap between a problem state and the anticipated goal”. Dogru (2008) reiterates that, in problem solving methods, teaching includes integration of concepts and skills to get over unusual situations and solving problems is seen even to take place in unplanned territory where new solutions for the problem are found. Solving problems in general involves devising ways to answer questions and to meet a situation which presents a challenge to people (Isaksen, Dorval & Treffinger, 2011; see also Lotz-Sisitka, 2011).

Kirkley argues that we should promote problem solving skills for children in schools (*ibid*). He believes that problem solving is a basic skill needed by today’s learners and each country needs to revise its curricula to include integrated learning environments which encourage learners to use higher order thinking skills, and in particular, problem solving skills. Kirkley explains that learners often learn facts through rote learning with few ties to the context and application of knowledge. According to him problem solving has become the means to re-join content and application in a learning environment for basic skills as well as their application in various contexts. Kirkley (2003) maintains that the problem solving method is an interdisciplinary teaching method that empowers learners to take actions. Also emphasised by Isaksen, et al.,

(2011; see also Treffinger, 2011) is that in some situations, people enjoy solving problems, because they see problem solving as a way of overcoming difficulties or life challenges. On the other hand, people associate problem solving with words such as ‘anxious’ and ‘danger’ and these make them reluctant to engage in problem solving activities.

To take this discussion further some research has been done on the teaching of problem solving processes in the field of environmental education. Jensen and Schnack (1997) state that there has been a trend in environmental education to give pupils knowledge about the seriousness and extent of the environmental problems. According to O’Donoghue (2001) this kind of teaching approach only tends to provide learners with more information about environmental issues, but it does not support them to do something about the problems.

Jensen and Schnack (1997) distinguish between action and activity in environmental education, arguing that one of the key features of an action is that it needs to enable learners to participate in investigating and solving environmental problems. Jensen and Schnack have found in their studies that action in lesson plans often appears to be understood as action for activity’s sake, with little evidence of in-depth understanding of the issue being learned. In most cases, they observe that often learners do not understand why they are doing activities. The Environmental Protection Agency [EPA] (1992, cited in Potter, 2010) points out that environmental education should provide “knowledge about environmental issues and skills necessary to make informed environmental decisions and to take responsible action” (p.23). Potter (2010) further says that environmental education teaches individuals how to weigh various aspects of issues through critical thinking, problem solving, and decision making skills. Further emphasis on problem-solving is found in Short (2010) who states that learners need every opportunity to learn by being engaged in environmental issues through actions. Short further indicates that learners need encouragement to act autonomously on what they have learned in a way which they determine is the best contribution to solving problems and issues. He also argues that the goal of the teacher in teaching environmental education should “be to objectively explore those pedagogical methods that are most likely to translate into a citizenry of thoughtful, effective problem-solvers

who make significant environmental impacts later in life” (ibid, p. 10, see also Lotz-Sisitka & Lupele, 2012).

As noted in the discussion above the authors are suggesting that environmental education supports learning through action activities in problem solving processes. In addition, some authors implicitly stressed that when learners are engaged in environmental activities through action this allows learners to arrive at their own ways of solving environmental issues instead of the predetermined outcomes set by teachers. “Hence teachers are facilitators who create opportunities rather than prescribing solutions” (Gooch, Rigano, Hickey, 2008, p.176). Jensen and Schnack (1997) argue that “the aim of environmental education must be to make present and future citizens capable of acting on a societal as well as a personal level” (p. 164). Chawla and Cushing also believe that the goal of environmental education is not simply environmental action, but rather that the most strategic action in the public or private sphere must be the aim (2001 cited in Short, 2010).

According to O’Donoghue (2001), early teaching methods in environmental education were dominated by a lecturing teaching approach. He observed that “most teachers taught the environment as a world of problems and wild nature at risk. Teaching ecology and environmental education was seen as the same thing. Teachers viewed the environment simply as nature at risk” (ibid, p. 6). O’Donoghue (2001) goes on to say that such teaching approaches were not solving any environmental issues and problems because they did not transform the learner into a critical thinker and problem solver. Commenting on teaching methods in environmental education in southern Africa Rosenberg, O’Donoghue and Olvitt (2008) note that other methods are needed in teaching environmental education when dealing with environmental problems in order to take action that promotes better environmental sustainability practices. Rosenberg, O’Donoghue and Olvitt (*ibid*) identify teaching methods that will help teachers to engage learners in learning activities in order to acquire a better understanding of environmental issues and promote action.

Rosenberg et al (2008) argue that over time, environmental educators raised their concern about the use of a limited variety of teaching methods in dealing with environmental issues in environmental education. Today we find a richer range of teaching methods being used in addressing environmental issues (*ibid*, 2008). They further say that it is useful to realize that a teaching method which is described by one name can give rise to very different educational processes, because it can be used in different ways, drawing on different assumptions, by different educators.

Rosenberg et al., (2008) say that “all these methods can be appropriate depending on the situation, the educational purposes we want to achieve, and how we use them” (p.12). Different methods put forward by these authors are discussed below specifically in terms of their relation to problem solving.

This section was developed in order to gain insight into methods toward Goal 3 of the study which look at methods and processes for problem solving. These teaching methods are:

Relating to prior knowledge and lived experience

This teaching method allows the teacher to explore learners’ prior knowledge and experience in relation to options for sustainable lifestyles. The assumption is that this teaching method is situated in time and place and hence has more meaning for learners. Relating the problem-solving processes to learners’ prior knowledge and lived experience will enable learners to situate their learning within their cultural context and draw on their prior knowledge and experiences (Rosenberg, et al., 2008).

The positive side of this teaching method is that it helps learners to analyse processes in which people traditionally knew and valued their local environment and addressed environmental issues. Rosenberg, et al., (2008) warning that if this method is not properly used a teacher might set lived experience against modern, scientific knowledge instead of reflecting on what each tells us about problem solving processes(Rosenberg, et al., 2008) .

Field Trips

This teaching method allows the teacher to take learners on a trip and visit one or more sites of environmental concern. According to Rosenberg et al., (2008) the purpose of this teaching method is to solve environmental problems through social learning.

The positive side of this teaching method is that it helps learners to see things differently and allows them to think outside existing frameworks of problem solving processes. In contrast, if a teacher does not prepare any supportive materials to guide learners and assumes that learners know what to look for, this method might not support learning. This teaching method is always time consuming. It often leaves little time to reflect on learning processes as well as engaging in further discussions.

Literature analysis method

This teaching method requires the teacher to use media/books for learners to read and analyse the information in the text in relation with environmental issues. In so doing, learners have the opportunity to unpack text or media they are using with the guidance of direct questions such as:

- How does it present the environment?
- How does it present people's relationship to the environment?
- How does it present the values of care and responsibility towards the environment?

According to Rosenberg et al., (2008) the assumption is that learners should become critically aware of the intentions behind media messages and to reflect on the implications of these messages for people and planet in problem solving processes.

The positive aspect of this teaching method is that it shapes learners' cultural values as they engage in learning processes. It also allows learners to consider their own lifestyle and to consider ways for doing things differently. However, this teaching method does not necessarily mean that learners will be able to take necessary action or engage in problem solving processes,

because they are made aware of environmental problems. It also does not give much room for learners to solve environmental problems by doing (Rosenberg, et al., 2008).

Guided Questioning

This teaching method allows the teacher to probe and use structured questions to direct learners' thinking about particular aspects of environmental problems. According to Rosenberg et al., (2008) this teaching method guides the learners' thinking and supports them step-by-step to think more about environmental problems through problem solving processes. The assumption behind this teaching method in problem solving processes is that "learning requires learners to think for themselves and to make connections between what they already know, and what they are presently experiencing and interpreting" (Rosenberg et al., 2008, p. 13).

The positive side of this teaching method is that it allows the learners to feel increasingly involved in the processes of problem solving and to develop their confidence and motivation to learn when they are given the chance to think things through for themselves and suggest answers. Guided questioning also creates a stimulating and more interactive learning experience in learners. In contrast, if a teacher asks questions in an inappropriate way it could make learners feel as if they are being examined. If this teaching method is not used carefully by the teacher in maximizing the learners' participation the teacher may become dominating. It runs the danger of teachers assuming that learners have enough prior knowledge and experience to draw on in order to answer the questions. If learners are in a completely new environment or they have limited knowledge to draw on, the processes of problem solving can be affected (ibid, 2008).

Demonstrations and Experiments

The underlying assumption is that this teaching method allows the teacher to work with learners by demonstrating something they are studying in order to clarify information and concepts. Through this, learners can reflect their understanding of how something operates. According to Rosenberg et al., (2008) 'seeing is believing' and environmental issues or concepts that are explained at an abstract level do not support problem solving processes as strongly as demonstration or experiment, because of the latter being more tangible nature. They further say

that this teaching method, if used properly scaffolds the development of complex concepts. This helps the teacher to focus learners' attention on a few selected features or concepts in real-life situations in problem solving processes when dealing with environmental issues (*ibid*).

A further positive side of this teaching method is that learners can make their own models to reflect their understanding of how something operates. Rosenberg et al., (2008) say that through demonstrations and experiments learners can develop a sense of enquiry and develop skills of observation and prediction which also supports the processes of problem solving. On the contrary demonstrations and experiments have some negative sides which may affect the successful implementation of problem solving processes. Firstly, teachers may assume that learners have made the connection between the demonstrations or experiment and the real world, when in fact they might not have. Secondly, this teaching method if, not used properly may result in a very teacher centred activities with learners playing a passive role in the problem solving processes.

2.5 Problem solving teaching methods in Geography education

Chappell (2001, cited in Golightly & Muniz, 2013) say that the interdisciplinary nature of Geography education fits well within a problem-based learning approach as a framework for teaching and learning. Golightly & Muniz (*ibid*) argue that a problem-based learning approach develops problem solving skills suitable for real-world situations where problems do not fall naturally into academic disciplines. They argue that problem based learning puts learners at the centre of the learning activity and makes them accountable for their own learning. In so doing, problem-based learning promotes a learner-centred approach which shifts the classroom focus from teaching to learning (see also Ratinen & Keinonen, 2011). By using problem-based learning a teacher becomes a facilitator who guides learners' learning experiences while problems drive the learning. In problem-based learning, the teacher should identify a problem, based on desired curriculum basic competencies and compelling problematic situations from the real world (Fournier, 2002 cited in Golightly & Muniz, 2013). The problem-based learning process, according to Simons, Klein and Brush (2004, cited in Golightly & Muniz, 2013), is anchored by a complex problem for which there are many solutions. Problem-based learning

takes place in small student groups, in which collaborative learning, sharing and negotiating information and knowledge is of prime importance (ibid). The effective implementation of problem-based learning in Geography education can assist learners in the development of effective problem solving skills and self-directed life-long learning skills, and to become effective collaborators and become intrinsically motivated to learn. Problem-based learning also provides students with opportunities to consider how the facts they acquire relate to a specific problem at hand. In regard to this Ketlhoilwe (2010) argues that application of problem solving and project-based learning helps learners to make significant and meaningful responses towards achieving sustainable development.

2.6 Environmental problems in the Namibian Geography syllabus

The Namibian constitution - *Article 95* outlines the importance of integrating environmental learning into the formal education curriculum (Imene, 1999). The National Development Plan 1 (NDP1) and the Namibian Environmental Education Network (NEEN) recognised environmental learning as an imperative for sustainable development in Namibia (Namibia. NEEN, 2004). Part of its plan was to incorporate environmental issues (see Table 2.1) and sustainable development in the formal education curriculum (Namibia. NEEN, 2004). The MoE (2009) describes two influential projects which brought environmental issue to be taught in the Namibian curriculum namely; the Enviroteach Project and the Life Sciences Project. Enviroteach was a substantive international development assistance intervention in the context of apartheid education transformation in Namibian. Enviroteach project gave attention to teacher development and supporting environmental learning in the Namibian curriculum reform process. These projects were fundamental in promoting the idea for understanding of environmental problems in the Namibian Pilot curriculum (1996-2006).

According to MoE (2008) the Geography syllabus like other syllabi should address cross-curricula issues through geographic perspectives. The cross-curricular issues which have been introduced into the formal curriculum as themes to be dealt with in each subject are: Environmental Learning, HIV/AIDS, and Education for Human Rights, Population Education,

and Information Communication Technology. The Geography syllabus further states that all learners need to:

- Understand the nature of these risks and challenges
- Know how they will impact on our society and on the quality of life of our people now and in the future
- Understand how these risks and challenges can be addressed on a national and global level
- Understand how each learner can play his or her part in addressing these risks and challenges in their own school and community

(MoE, 2008, p.4)

The Geography syllabus also makes provision for the teaching of environmental problems by identifying a number of environmental challenges and risks as indicated below:

- The challenges and risks we face if we do not care for and manage our natural resources
- The challenges and risks caused by HIV and AIDS
- The challenges and risks to health caused by pollution, poor sanitation and waste
- The challenges and risks to democracy and social stability caused by inequity and governance that ignores rights and responsibilities
- The challenges and risks we face from globalization, including ICT

(MoE, 2008, p.4)

2.7 Problem solving in the Namibia Geography syllabus

Besides an interest in understanding environmental problems Namibian policies also presents an interest in resolving these problems. This is driven, for example, by the Constitution which aims are to build a nation that has a solid understanding of environmental problems and to promote responsibility toward ecological sustainability and improve quality of life (Namibia. NEEN, 2004). The integration of environmental education in the formal education curriculum can provide active learning opportunities that promote critical thinking and environmental problem

solving amongst learners (Imene, 1999). According to Amutenya (2009) the Namibian curriculum after independence has shifted to a more learner-centred approach which aims to promote problem-solving as one of its teaching strategies. The post-independence curriculum reform (1990-2006) stated that learners should be engaged in learning that promotes learners as problem-solvers rather than as passive recipients of information (MoE, 2008).

The revised curriculum notes that: “The teacher can help develop learners’ thinking capacity by engaging the learners in problem-solving activities where increasingly broader knowledge is applied to ever more complex problems and situations” (Namibia. MoE, 2008, p. 30).

Teaching learners to solve environmental problems in Geography requires extensive understanding of the challenges that the world is facing as a global society. In order to achieve this in Geography, the teaching of environment problems should be centred on analyzing and evaluating environmental issues to promote problem solving skills in order to understand humans and their relationship with the bio-physical environment and how to solve tensions and contradictions that arise within this relationship (Namibia. MoE, 2008). *The Environmental Learning in Namibia Curriculum Guideline for Educators* suggests that all subjects including Geography should address environmental challenges (Murray, 2005). According to Murray (*ibid*) environmental education was incorporated in the Geography syllabus to offer opportunities to enable learners to:

- Examine issues at a range of scales and note the linkages between them
- Help learners to understand the relationships between countries in terms of space, resources and the inter-actions of activities on each other
- Integrate problem-solving skills as an essential component in its coursework

The Namibia Geography syllabus states that the teaching of environmental learning in Geography should make a link between learners and the real world (Namibia. MoE, 2008). It further asserts that Geography provides learners with an understanding of the ‘risks and challenges’ in their world that need to be addressed in order to improve the quality of their lives and the health of their environment. This is particularly in relation to the Ecology topic specified

in the Grade 10 curriculum where learners are expected to “suggest solutions to environmental problems experienced” (Namibia. MoE, 2008, p. 65). The Namibian MoE (2008) points out that “Geography provides learners with an understanding about the political, social, economic and biophysical dimensions of the world that enable them to operate in their society and the environment as responsible citizens” (p. 2). It further points out that the aim of teaching environmental learning in Geography is to provide a holistic and inter-disciplinary understanding of different skills needed to address environmental problems (*ibid*).

As noted in the above discussion the Grade 10 Geography syllabus (2008) and National Curriculum (2008) provides opportunities to support the teaching of problem solving in Geography. According to Murray (2005, p. 50) “enquiry-based learning is supported throughout the formal school curriculum from Grades 1-12, and specifically identified and encouraged, in subjects such as Environmental Studies, Science, Geography, Social Studies and Development Studies”. He further says that this enquiry-based learning provides an ‘open learning’ framework that encourages learner choice and negotiation, reflection on the learning and teaching process, an emphasis on critical thinking and active ‘real life’ learning (*ibid*). He continues to say that an enquiry-based learning model is based on problem solving. It encourages learners to research their own questions, present and analyse data and identify possible solutions that they or others may be able to implement (*ibid*). Figure 2.1 below illustrates Murray’s approach to enquiry-based learning using an open learning problem solving model.



Figure 2.1 Enquiry-based learning (Murray, 2005)

According to Murray (2005) the Ministry of Education suggested this model could be used in all subjects, because it gave guidelines on how to implement enquiry-based learning in the Namibian syllabus, including in Geography. This study seeks to relate this enquiry-based learning model to Grade 10 environmental problem-solving activities in Grade 10 Geography classrooms.

The Murray enquiry-based learning model can be compared with three other related environmental education problem solving models which are used in teaching environmental problems in core learning subjects (UNESCO, 2002). These are: a model of enquiry learning, a future problem solving model and a community problem solving model. Murray's enquiry learning model is a cyclical learning process while the other models are presented as linear. This cyclical learning process, gives room for learners to evaluate environmental problems through problem solving learning activities by changing or identifying new problems and repeating the process again. Table 2.2 further compares the process of the three models described by UNESCO in relation to the five steps in Murray's enquiry-based learning model (see Figure 2.1).

Table 2.2 Comparative table of different problem solving models used in teaching environmental education in core subjects

STEPS	MODELS			
	Murray's Enquiry-based learning model	Model of enquiry learning	Future problem solving model	Community problem solving model
Step 1	Identifying the issues and sharing ideas	Tuning in	Not specified	Exploring community concerns Selecting problems
Step 2	Planning and researching (investigating the problem)	Preparing to find out Finding out	Identifying possible causes and effects of a problem	Investigating
Step 3	Analysing and presenting the information	Sorting out Drawing conclusions	Identifying the underlying problem	Not specified
Step 4	Finding possible solutions and taking action	Considering social action	Brainstorming potential solutions Evaluating solutions determine best one Developing an action plan	Planning actions Taking action
Step 5	Did it work? Change or identify new problem and repeat the process	Not specified	Not specified	Evaluating actions and changes. Developing visions of sustainable futures

Some differences and similarities highlighted by this table are discussed below.

Model of enquiry learning

This model involves learners in environmental learning activities actively in the light of the different sorts of information available to them (UNESCO, 2002). Four steps of this model are addressing the first four steps of Murray's enquiry-based learning model. What is different in this model is that it does not include step 5 of Murray's model which requires thinking about whether the action taken worked and making plans to repeat the process if necessary.

Future problem solving model

This is one of the models a teacher can use to engage learners practically in environmental learning activities to help them to develop skills for solving environmental problems (UNESCO, 2002). This model covers steps 2-4 of Murray's enquiry-based learning model.

Community problem solving model

This model helps a teacher to provide learning opportunities for learners to practice the skills that are needed to participate in finding solutions to the local issues that concern them, with a view to working towards a more sustainable future (UNESCO, 2002). This model covers the four steps of Murray's enquiry-based learning model, step 3 of Murray's model is missing.

In the analysis of data for this study Murray's enquiry-based model and other comparative models were used in order to help describe problem-solving methods as was the purpose of Goals 3 and 4 of the study.

2.8 Environmental problems in the context of risk society

In this section Beck's (1992) thesis of risk society is used to broaden an understanding of the concept of environmental problems. In this study this broadened understanding of environmental problems is used to gain insight into how the complexity of environmental issues is addressed in the cases under examination. Beck's work centres on the concept of risk which emerged as a result of development and economic innovation (*ibid*, 1992). He notes that it is now useful for people to know that the whole world is facing a shift from a scarcity society to a risk society. He defines risk as a 'potential danger that may occur in the future and which is always based on

mathematical possibilities” (1992, p. 27). Beck adds that risk is a systematic way of understanding hazards and insecurities induced by development and economic growth.

Giddens (1999) supports Beck’s view that the notion of risk is inseparable from the ideas of probability and uncertainty, because environmental risks are referring to hazards that are actively assessed in relation to future possibilities. Beck’s thesis provides some examples of environmental problems which are detected by humans such as radioactivity and toxins and pollutants in the air, in water and foodstuffs (*ibid*). With this view of risk, environmental problems do not necessarily refer to a natural phenomenon, but a possibility that something bad might happen.

In his thesis of risk society Beck (1992) discusses different characteristics of risk. Particularly, three characteristics of risk society are discussed below.

2.8.1 Risk as socio-ecological

According to Beck (1992) risks do not only affect the ecological sphere (such as through air pollution and deforestation), but they affect, social, political and economic dimensions of society (diseases, poverty, unemployment, and civil war over resources). These can be seen for instance, when a government encourages the use of genetic modified seeds to increase yield or to maximize the use of limited resources for job creation and economic growth. Or in Beck’s explanation “fish from the contaminated seas endanger not just the people who eat them, but also all the many people who make a living from fishing” (p. 39). Hattingh (2004) endorses the view of environmental risk as socio-ecological. He argues that biophysical challenges are linked to social, political and economic problems. Hattingh explains that “activities in one sphere may have a negative impact, even to the point of disruption or destruction, on the other spheres” (*ibid*, p. 160). He further explains that the social, political and economic spheres rest within the ecological sphere. If there are problems in the ecological sphere, the social, political and economic spheres will be affected.

Luhmann (1993) asserts that in the past environmental issues were perceived to derive from natural disasters such as storms, floods or epidemics rather than human creations. Luhmann

argues that environmental problems were not seen as caused by humans in isolation, but were seen as natural phenomenon in a modern society. According to the Brundtland Report (cited in De la Court, 1990) people need to have a broader perspective of environmental problems to help them understand ecological problems which have their root cause in social and economic problems. Likewise Beck (1992, p.81) said that “environmental problems are not problems of our surroundings, but in their origins and through their consequences are social problems, problems of the people”.

2.8.2. Risk assessment through scientific and social rationality

Beck’s thesis of risk society has challenged a belief that science is the sole guide of reasoning and truth (1992). He highlights that both scientific and social reasoning are needed to define and assess risk. He argues that historically an argument regarding risk which was not scientifically championed or proven was not deemed worthy of attention, because in the past scientists had monopolized the definition and assessment of risks. Beck argues that the risks that societies are facing nowadays need scientific and social knowledge to be understood by people, since those risks are no more defined by scientific reasoning alone, but also by society’s experiences (*ibid*). Beck (*ibid*) argues that in the past there were splits and gaps between scientific and social rationality in understanding the risks. Beck asserts that social rationality always raised questions that were not answered by the scientists at all and the scientists answered questions which missed the point of what was really asked and which fed public anxiety (*ibid*). Beck (*ibid*) explains that “scientific and social rationality do indeed break apart, but they remain at the same time interwoven and interdependent” (*ibid*, p. 30). He also believes that “scientific rationality without social rationality remains empty, but social rationality without scientific rationality remains blind” (*ibid*, p. 30). This illustrates that scientific and social reasoning should work as a unity to define and assess risks. Cottle (1998) and Irwin (2001) also endorse Beck’s view that scientific and social rationality are needed to assess and take control of their own identified risks. Cottle (1998) argues that challenges being faced from risks cannot be understood by merely improving scientific expertise and technological development, but a social voice needs to be given attention in the processes. The social voice too can play a greater role in improving scientific reasoning in working and understanding risks (*ibid*).

2.8.3 Risk as local and global issues

Beck (1992) notes that risk has changed from a local to a cross border concern which often affects the global village. He states that risks are no longer tied to their place of origin; therefore it is not enough for people now to discuss risk as a local concern rather than an international concern. Mythen (2004, p. 32) argues that risks have “a boundless collection of environmental problems such as air pollution, global warming and acid rain”. Mythen emphasises the relationship between local and global, highlighting that locally produced risks create global consequences. He maintains Beck’s view that risks have now de-localized, because their causes and consequences are now not limited to one geographical location, and are now universal. For example, swine flu that was first reported in Asia reached Africa through trade in foodstuff. Therefore, people are now living with risk that is rooted in their own actions and those of others from a distance. As a result of global risks, the ‘distant others’ had become the ‘nearby others’ (Beck, 1992). In further examples, environmental risks such as air pollution, chemicals in food stuff, conflict over resources and biotechnology, are a concern for even those countries that are not highly industrialized (*ibid*). Beck (*ibid*) gives examples to justify his arguments. He says that forests have been dying for some centuries, but now faster than before, “first through being transformed into fields, then through reckless overcutting, but the death of forests today occurs globally as the implicit consequence of industrialization with quite different social and political consequence” (p. 20). He specifically pointed to African countries that have few industries, but which are battling against pollution from highly industrialised countries which is affecting plants and animals. Lotz-Sisitka (2004) also draws on Beck’s thesis of risk society to explain that “risks move freely around the globe and associated risks become delinked from geo-physical boundaries” (p. 44). Drawing on Beck she argues from a southern African perspective that southern African citizens are the most affected by risks that are not locally produced such as pollution and global warming. For example food insecurity and poverty is aggravated by “drought and flood” which is affecting the African continent more than other continents because of the effect of climate change (Lotz-Sisitka, 2004). Likewise Le Grange, Reddy and Beets (2011 cited in Reddy, 2011, p. 11) draw on Beck to argue that “many environmental problems

such as climate change transcend national borders” and then become global problems that affect everybody.

2.9 Problem solving and social constructivist learning theory

This upcoming section presents a reflection on social constructivism - the theoretical lens which was used to describe the problem-solving processes in this study. The theory of social constructivism was applied in this study to deepen understanding of problem solving processes. Daniels (2004) explains that the origin of social constructivism can be traced to the Russian psychologist Vygotsky. Daniels (2004) explains Vygotsky’s argument that children are at their highest peak of learning when they are collaborating with more skilled partners to construct knowledge and solve problems. Janse van Rensburg and Lotz-Sisitka (2000) describe social constructivism as a theory of acquiring knowledge that is constructed socially by human beings in working with others. This theory has influence on the nature of teaching and learning processes. Slavin (2012) identifies four key principles derived from Vygotsky’s ideas which have played an important role in cognitive development: 1) social engagement, 2) language, 3) the zone of proximal development [ZPD] and 4) scaffolding. I will discuss each principle in more detail below.

2.9.1 Socio-cultural context in cognitive development and problem solving

Vygotsky’s theory of social constructivism emphasises the importance of understanding the influence of social context on learning. In Vygotsky’s theory both parents and older children play important roles in learning. According to Vygotsky (1978, cited in Berk and Winsler, 1995) cognitive development takes place in socio-cultural context when children collaborate through dialogue with more knowledgeable members of their society during challenging tasks (see Daniels, 2004; McInerney & McInerney, 2006). In so doing, children learn to think and behave in ways that reflect their community’s culture. Children imitate most of the things their parents do or things that their society does. This socio-cultural interaction is one of the important tools which promote learning and thinking according to social constructivist theory (Hodson and Hodson, 1998). According to Hodson and Hodson (*ibid*), traditionally parents teach their

children at home how to calculate and solve riddles. For example parents send their children to buy or sell sweets. In this way children start to learn basic mathematics in society. By interacting with people a child starts to understand his/her own world through cultural events which helps the child to learn what is important and to solve his/her own problems. Berk & Winsler (1995) further point out that mature partners offer guidance to children in mastering culturally meaningful activities and communication with these partners becomes part of children's thinking. This was supported by van der Veer & Valsiner (1991, cited in Berk & Winsler 1995) who state that "once children internalize the essential features of these dialogues, they can use the strategies embedded in them to guide their own actions and accomplish skills on their own" (p. 19).

Social engagement is important in social learning process, because it allows meaningful learning to take place as learners engage in social activities that promote problem solving. Sutinen (2008, cited in Tuckman & Monetti, 2011, p. 311) argues that education is the medium in which the creative and constructive actions of individuals come together in a social environment. The essential role for teachers is to help learners to construct understanding in a social setting. In this way social interaction is seen as natural processes whereby learners share experiences and construct their own knowledge and problem-solving capacity. Slavin (2012) concurs that through social interactions, learners learn from each other on how they work in social settings. He further says that learners talk to themselves and others through solving difficult problems.

2.9.2 The importance of language in problem solving

Language is used as a tool for communicating learning. According to Berk and Winsler (1995) Vygotsky emphasised that language is an important tool of the mind and learning. Berk and Winsler (1995, p. 21) make the point that "the notion that language shapes mental functioning" is one of the influential ideas in Vygotsky's approach. Berk and Winsler further argue that language is a product of social history of a collective effort to create a social way of life. They further argue that language is the most flexible psychological tool used for communication (see also McInerney and McInerney, 2006). Berk and Winsler elaborate by explaining that language plays a role on a psychological level, since it is a major means for influencing thinking and

behaviour of another person or one's self. Hodson and Hodson (1998, p. 35) argue that it is through the use of language by parents or peers, and later via teachers that children learn to acquire communicative tools and skills which allow them to solve problems. Hodson and Hodson (*ibid*) highlight the way in which children come to use language as a tool for problem-solving. By using language children solve any problem (*ibid*). Language functions as the means by which learners co-construct meaning as they plan, act, interpret, report and reflect together in their learning processes (*ibid*, 2008). Clark (1998 cited in Daniels, 2004) acknowledges that language is a tool that joins individual functioning and social-institutional activity. Daniels (2004) argues that:

When a child, confronted by a tricky challenge, is talked through the problem by a more experienced agent, the child can often succeed at tasks which would otherwise prove impossible. Later on when the adult is absent, the child can conduct a similar dialogue, but this time with herself. But even in this latter case, it is argued the speech functions so as to guide behaviour, to focus attention, and to guard against common errors. In such cases, the role of language is to guide and shape our own...behaviour—it is...a tool for structuring and controlling action and not merely a medium of information transfer between agents.

(p. 65)

According to McInerney and McInerney (2006) teachers should understand the relationship that exists between language and learning in order to promote problem solving activities in their teaching. They further reiterate that language which is a public speech that guides children's behaviour allows them to work out how to use self-talk through social interaction to solve problems in their daily lives. Moreover, as children develop their language, they become more able to use their own speech, rather than the speech of others to guide their behaviour and solve problems (McInerney & McInerney, *ibid*). McInerney and McInerney (*ibid*) argue that teachers who develop learners through language as a tool for higher mental processes promote learners' higher thinking skills such as planning, evaluating, remembering, reasoning and problem solving throughout life. Slavin (2012) stresses that learners become experienced through others, not only in how they learn, but in what they learn. The language and culture determine the process of learning and knowledge construction. To take this discussion further Berk and Winsler (1995) maintain that "the use of language by an adult, combined with adult reduction of regulation as children's competence increases, leads children to use speech to solve problems" (p. 46). As a

result, children will realise that they can answer their own questions and scaffold themselves. Consequently, through language as a tool for scaffolding, learners will begin to create and expand their own learning.

From the above scholars it is clear that language is an instrumental tool in learning. Learners need extensive interaction with those who have more experience in social interaction, and language is a tool for learning.

2.9.3 Zone of proximal development in problem solving processes

Another core element of Vygotsky's theory is his notion of a zone of proximal development (ZPD). According to Berk and Winsler (1995) Vygotsky's general law of cultural development states that learning in learners appears twice; firstly it develops during collaboration with adults or more competent peers and secondly it is internalised to become part of the child's psychological world. According to Vygotsky (1978 cited in Berk & Winsler, 1995) the space in which learning takes place occurs in an area he called the ZPD. Authors like Berk and Winsler (1995), Moll (2002), Daniels (2004) and McInerney and McInerney (2006) define the ZPD as the distance between the actual developmental level as determined by independent problem solving, and potential development at a level determined through problem solving under adult guidance or in collaboration with more capable peers. Berk and Winsler (1995) maintain that within their ZPD children collaborate and interact with teachers and other learners to construct new cognitive abilities that will help them to solve problems in their lives. In the same way Daniels (2004) suggests that what we should be measuring is not what children can do by themselves or already know but rather what they can do with the help of another person and have the potential to learn. Moreover, ZPD provides a dynamic zone of sensitivity in which a teacher and learners work together on tasks that learners could not perform independently because of the difficulty level, but can excel in with the help of the teacher.

Furthermore, Schunk (1996) points out that a teacher can use the notion of the ZPD to identify which skills can most effectively be taught to the learners to solve a particular problem.

2.9.4 Role of the teacher and teaching strategies for scaffolding problem-solving

The fourth element in Vygotsky's theory (which was developed by Bruner in 1968 to further elaborate on the notion of the ZPD) is 'scaffolding' which deals with teacher and learner interaction during learning processes.

According to Berk and Winsler (1995) scaffolding engages learners in collaboration with the teacher in problem-solving activities and maximises children's willingness to take part positively in challenging activities. Berk and Winsler (*ibid*) further provide two interesting insights on the role of scaffolding in learning. Firstly, scaffolding, "keeps children working on task in their ZPDs" (p. 29). To illustrate this, Berk and Winsler (*ibid*) argue that teachers can provide scaffolding to learners in two ways: (1) by structuring the task and the surrounding environment so that the demands on the child at any given time are at an appropriate level, and (2) constantly adjusting the amount of adult intervention to the child's current needs and abilities (*ibid*). Berk and Winsler (*ibid*) and Schunk (1996) agree that the role of education is to provide children with activities that challenge them and which can be accomplished with sensitive adult guidance. The teacher's role is to keep tasks slightly above children's levels of independent functioning rather than giving them tasks which they can perform independently. McInerney and McInerney (2006) argue that teaching in school can only be good when it awakens those functions which are in a stage of maturing, which lie in the zone of proximal development. Daniels (2004) acknowledges that teachers need to place appropriate learning activities in the ZPD and the level for the activities should not be too difficult. Teachers need to provide support until learners have mastered the skills needed to function alone.

Hodson and Hodson (1998, p. 36) argue that "teachers should concentrate their efforts in the zone of proximal development", because that is where good learning and advance of development occurs. They further outline that it is very important during scaffolding for teachers not to alter the nature of the problem for the learner; rather they should hold the problem constant while fine-tuning the nature of the learner's participation through graduated assistance. Likewise Daniels (2004) argues that teaching can be said to occur when assistance is offered at points in the ZPD at which performance requires assistance. In addition Scott (2008) argues that

a learner who is uncertain about the contours of the task, what the task entails and therefore what a proper solution to the task might be, is unlikely to be able to complete it without assistance.

Berk and Winsler (1995) argue that scaffolding “fosters self-regulation by allowing the child to regulate joint activity as much as possible” (p. 30). The teacher is required to hand over control as soon as the child can work independently on a given problem. Berk and Winsler (*ibid*) also believe that what has become a problem in learning is the way in which some teachers explicitly give learners immediate answers, when learners are struggling with tasks. In contrast to this they say teachers should scaffold learners by asking them questions such as probing questions that promote participation in finding solution to the given tasks. Tuckman and Monetti (2011) suggest that teachers should provide students with scaffolding by helping or supporting them through the use of prompt questions and peer interactions to solve problems. It is essential for teachers and peers to simplify the tasks, provide direction, stimulate motivation and offer feedback in order to minimize frustration so that children can accomplish the given task.

According to Moll (1990 cited in Scott 2008, p. 87) scaffolding can take place in different forms such as “demonstration, asking questions and introducing the initial elements of the task’s solution”. Scott (2008) further argues that scaffolding then becomes a structure of guidance in which the novice engages with the expert to solve a problem or carry out a task. He also reiterates that scaffolding does not happen in a vacuum, but in the zone of proximal development in order to bridge this gap. It can be argued that through socio-cultural processes children’s problem solving seems to improve most when their partner is an expert (a person especially capable at the task) who can provide new ways of approaching the situation not already within the child’s repertoire (Berk & Winsler, 1995).

Hence the teachers are key players in scaffolding learners through problems, because they need to know how to help learners to expand their ZPD through assisting them to complete challenging tasks alone.

2.10 Conclusion

This chapter provided a theoretical framework for the study specifically relating to the presentation of environmental problems and how these are defined in the Namibian context. It covered significant events in international conventions regarding the development of environmental concerns nationally, regionally and internationally. The chapter further discussed problem solving in teaching and illustrated how it is defined in Geography education, the different approaches and styles in problem solving, and some of the problem based approaches in environmental education. As indicated in this chapter, there are a variety of ways of presenting environmental problems and implementing problem solving methods. The understanding of the representation of environmental problems in a risk society and the characteristics of risks constituted one of the main discussions in this chapter. These included understanding risk as a socio-ecological issue, risk as scientifically and socially rationalised, as well as risk as both local and global. Many of the risks discussed in the literature, can be observed in the Namibian education landscape with specific reference to environmental challenges in Murray (2005) *Environmental Learning in Namibia, Curriculum Guidelines for Educators* and also in the geography syllabus. This chapter also discussed Vygotsky's social constructivism theory as a lens for reviewing problem solving methods and processes.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

The research approach selected for this study was determined by the purpose of this study, which was to investigate how environmental problems and problem-solving methods are presented in the Namibian Grade 10 Geography syllabus and how these are represented and implemented through teacher intentionality and practice.

This chapter begins with a description of the methodological framework for the research. The study is based within an interpretive research tradition, and the first section of this chapter explains the selection of this orientation. Secondly, the research context and participants are described, focusing particularly on the research setting and the criteria followed in selecting the three schools and the research participants. Thirdly, the chapter describes data generation methods and tools, which include document analysis, focus group discussion and classroom observation. This section includes a description of how data were recorded. The remaining sections focus on data analysis, validity, research ethics and limitations of the study.

3.2 Methodological framework

This study was conducted within an interpretive paradigm, which considers the experiences of individuals as the main data source for interpreting reality. According to Cohen, Manion & Morrison (2007) an interpretive paradigm allows the researcher to understand the situation of the phenomena being studied and to interpret explanations of phenomena given by the participants. This paradigm gives the researcher the opportunity to understand a situation or a set of phenomena through a process of interaction in which the participants' perceptions, interpretation and meaning that they give to their actions are explored (Cohen et al., 2007). Creswell (2002) points out that interpretive researchers are interested in the meaning that people make of phenomena. This research used an interpretive approach with the aim to understand environmental knowledge and educational decisions and actions that teachers take in their classroom. From an interpretive point of view, Merriam (1998) notes that human actions have reasons and take place within a structure of social rules in which they have meaning. She further

said that the task of the researcher is to understand what is going on through a process of negotiating meaning within a context. This was most suitable for my study as its focus was on the understanding of teachers' practice with regards to the use of problem solving in Geography. Cohen et al., (2007) state that the advantage of using interpretive research is to provide a rich description of the phenomenon being studied by a researcher.

I used an interpretive approach to allow me to explore and get a deeper understanding of the challenges teachers encounter in presenting environmental problems in their classroom and the challenges encountered in using problem-solving methods in teaching environmental learning in Geography. In addition, this research paradigm allowed me to interpret the experiences, thoughts, and opinions of the research participants in their own educational context. The advantage of conducting this study within the interpretive paradigm was to allow me, as the researcher, to understand and make sense of the actions and views of research participants from an individual perspective regarding the implementation of problem solving in Geography.

3.3 Research context and participants

This study is a small-scale interpretive study conducted at three schools in the Kavango region in the north-eastern region of Namibia. Three Grade 10 Geography teachers from three different schools of the Rundu circuit in Namibia participated in the study.

I purposely selected the three research participants based on a good relationship that we built during a contextual profiling process I conducted in 2011. These teachers and I are members of a professional development cluster working together in the Rundu circuit. After I explained the purpose of my study to the teachers, they showed an interest and volunteered for the study. They wanted to share their experiences of using problem-solving strategies in the context of environmental learning in their teaching.

3.4. Data generation

This study was conducted in two data generation phases. The first data generation phase entailed a document analysis of the Geography syllabus in order to understand how environmental problems are presented in the syllabus and problem-solving intentions evident in the syllabus.

This was followed by a focus group discussion with three Grade 10 Geography teachers from different schools in the Rundu circuit. This was done to probe participants' interpretation of the environmental issues and risks and intentions and experiences with problem-solving in the Geography syllabus. This was in keeping with an interpretive interest in understanding the situation of the phenomena being study (Section 3.2). The second data generation phase analysis of the study entailed classroom observations of two problem-solving lessons per teacher.

3.4.1 Document analysis

In the first data generation phase the Geography syllabus was selected to explore the representation of environmental problems in Geography (in response to Goal 1 of the study) as well as ideas and assumptions associated with learning and strategies for implementing problem-solving in the classroom (in response to Goal 3 of the study). Cohen et al. (2007) say that document analysis is important because it provides information and understanding of what happened in the classroom. Section 3.5 expands on the analysis of these documents.

3.4.2 Focus Group Discussion

Additionally, in first data generation phase of the study, a focus group discussion was used in order to explore participants' understandings of their everyday life practices. Focus group discussions "rely on the interaction of participants within the group, on the topic and on the questions provided by the researcher" (Cohen et al., 2007, p.398). Semi-structured questions were used during the focus group discussion to illicit discussion on environmental problems (in part response to Goal 1 of the study) and problem-solving teaching methods (in part response to Goal 2 of the study). McMillan and Schumacher (2006) described semi-structured questions as those questions that are organised around areas of particular interest, while still allowing considerable flexibility in scope and depth.

The focus group discussion was aimed to include three teachers. At the beginning of the focus group discussion one teacher was excused to go and attend a disciplinary hearing for one of his learners. As a result the focus group discussion only took place with two teachers, instead of three teachers. The focus group questions were informed by the Geography syllabus document

analysis described above. The focus group discussion, covered questions regarding how teachers understand environmental problems, how they introduce environmental problems to the learners, how they understand problem solving, how they introduce problem solving to the learners and how they engage learners in problem solving activities (Appendix 1). The focus group discussion allowed exploration of attitudes, feelings, beliefs, experiences and reactions towards the phenomenon being studied (Gibbs, 1997) as well as detail of the particular teaching strategies used by teachers.

The focus group discussion was video recorded and transcribed later (Appendix 2). The points raised from the focus group discussion were used to develop a framework for classroom observations.

3.4.3 Observation

Observation can lead to deeper understanding than an interview alone, because it provides knowledge of the context in which an event occurs and enables the researcher to see things of which the participants themselves are not aware or that they are unwilling to discuss (Patton, 1990). Robson (as cited in Cohen et al., 2007, p. 396) noted that “what people do may differ from what they say they do”. Cohen et al., (2007, p. 398) also note that observation enables a researcher “to look at everyday activities and behaviour that otherwise might be taken for granted or go unnoticed”. In this second phase of data generation, two lessons were observed of each of the three teachers and these were video recorded and transcribed (see an example of one of these transcriptions in Appendix 3). The lessons observed were those covering the topic ‘ecology’ which explicitly deals with problem-solving. This enabled an exploration of how teachers represent environmental problems (further to Goal 1 of the study) and how they implement problem solving strategies in their classroom (further to Goal 3 of the study). During the observations lesson plans were collected in order to help with the description of the classroom activities (See Appendix 7)

3.4.4 Summary of data generation tools

All lesson plans by the three different teachers covered the topic of ecology, but with different environmental themes. Teacher 1 planned two lesson plans for the implementation of two themes on ecology namely land pollution and deforestation. These were presented over two lessons to one group of learners. Teacher 2 planned and presented three themes (pollution , population and deforestation) in one lesson. This lesson was presented to two classes, but because the data was almost identical for the two classes the implementation of the lessons was presented as one case - drawing on both sets of data (T2-Ob1 and T2-Ob2). Teacher 3 planned and presented one theme (pollution) under the topic of ecology. This lesson was presented to two classes, but because the data was almost identical for the two classes the implementation of the lessons was presented as one case - drawing on both sets of data (T3-Ob1 and T3-Ob2). This accounts for the six classroom lessons observed for this study, that is two observations per teacher. Table 3.1 below shows themes covered by the three teachers as well as labels given to the respective observations.

Table 3.1 Lesson plans and themes

Teacher Observation label	Teacher 1		Teacher 2		Teacher 3	
	T1-Ob1	T1-Ob2	T2-Ob1	T2-Ob2	T3-Ob1	T3-Ob2
Lesson plan	Lesson Plan 1	Lesson Plan 2	Lesson Plan 1		Lesson Plan 1	
Themes	Land pollution	Deforestation	Pollution (air, water and land), Population and Deforestation		Pollution (air)	

A matrix of data generated for this study is presented in Table 3.2 below. This table shows what data generation methods were used and from which sources the data were collected. It also illustrates the purpose of each method and labels allocated to the data.

Table 3.2 Table summarising data generation methods

Data generation tools	Source of data	Purpose	label
Documentary evidence	Grade 10 Geography syllabus 2008	To understand how the syllabus represents environmental problems (Goal 1) and problem solving teaching methods (Goals 2).	GS
Focus group discussion	One focus group discussion (two teachers)	To explore teachers' knowledge of environmental problems (Goal 1), implementation of problem solving strategies (Goal 2), and representation of problem solving processes (Goal 3)	FT1 FT2
Lesson observations	Three teachers (six lessons observed, two per teacher)	To explore how environmental problems are represented (Goal 1), how problem solving strategies are implemented in practice (Goal 2), and representation of problem solving processes (Goal 3)	T1-Ob1 (L1-L33) & T1-Ob2 (L1-L29) T2-Ob1 (P1-P17) & T2-Ob2 (P1-P19) T3-Ob1 (L1-L33) & T3-Ob2 (L1-L27)

3.5. Data analysis

Patton (1990) states that interpretive research tends to use qualitative techniques for making sense and finding meaning in the data, interpreting what has been said and seen. Cohen et al., (2007) describe qualitative data analysis as a systematic process of coding, categorizing and

interpreting data. The data analysis in this study involved reducing accumulated data to a manageable size, developing summaries, and looking for patterns. This included data obtained from document analysis, focus group discussion and classroom observations. The data analysis process and development of categories was influenced by the research goals (Section 1.6).

All data generated were organized into three main analytic categories that were informed by the three research goals. The Table 3.3 below shows the three main analytic categories in response to research goals. This resulted in three phases of analysis and three analytic memos (see Appendices 4, 5 & 6).

The sub-categories for the analytic memos were directly related to the literature presented in Chapter 2 are elaborated in Table 3.3 below. The sub-categories of the main analytic category 1 were derived from Beck's (1992) thesis of risk society (Section 2.8) and related to Goal 1. The sub-categories of the main analytic category 2 were derived from Rosenberg, O'Donoghue and Olvit's (2008) description of teaching methods (Section 2.4) and related to Goal 2. The sub-categories of the main analytic category 3 were derived from problem-solving model based on an expansion version of Murray's (2005) enquiry-based learning model (Section 2.7) and related to Goal 3.

Table 3.3 Table showing the main analytic categories and sub-categories of data analysis

Main analytic categories	Sub-categories	Analytical Memo
1.Environmental problems (drawing on literature presented in section 2.8) (Goal 1)	socio-ecological	Memo 1
	Socially/scientifically rationalised	
	Local and global	
2.Teaching methods (drawing on literature presented in section 2.4)	Giving examples	Memo 2
	Relating to prior knowledge and lived experience	

(Goal 2)	Field based	
	Literature research	
	Guided questioning	
	Demonstration	
3. Amalgamated problem solving model (Expanded version of the Murray model drawing on literature presented in section 2.7) (Goal 3)	Identifying the issues and sharing ideas	Memo 3
	Planning and researching	
	Analysing and presenting the information	
	Finding possible solutions	
	Evaluating	
	Taking action	
	Did it work? Change or identify new problem and repeat the process	

3.6. Validity

I employed a multi-method approach in generating data for this qualitative study. Merriam defines triangulation as using “multiple sources of data or multiple methods to confirm the emerging findings” (1998, p. 204). Three methods of data generation were used namely: document analysis, focus group discussion and classroom observations that were triangulated to deepen my reading of the data. Using triangulation in this study helped to seek connections in the data collected through different tools and to confirm the categories and themes from literature (Creswell, 2002). The use of these multiple methods enabled me to view the same subject from more than one standpoint and thereby increase the validity of the findings. In so doing, it allowed me to compare the data and check the consistency of the data and identify where mismatches arose.

3.7. Ethical considerations

My position as a teacher within the Ministry of Education has given me access to schools in order to undertake this study. Throughout the research process, I ensured that my research participants were willing to participate. The strategies I employed to ensure this are discussed below.

As indicated above, I worked with three Grade 10 Geography teachers in the Rundu circuit, because I managed to build a good relationship with them when I did my contextual profile to clarify my research focus. Cavan (1977, cited in Cohen et al., 2007, p. 58) defines ethics “as a matter of principled sensitivity to the rights of others”. Bell (1993) argued that no researcher can demand access to an institution or materials. To fulfil this ethical aspect of the research, letters were written beforehand to the three teachers and their school principals (See Appendix 9) to get permission for the study and to get their agreement as participants. I informed the participants of the aim of the study and gave them the opportunity to choose whether to participate in the study after being informed.

Anonymity of learners was ensured as video material was only used by me and transcriptions did not make use of learner names.

According to Neuman (2000), a researcher has an ethical obligation to uphold confidentiality of data, which includes camouflaging members’ names in field notes. The research participants were assured that the data collected would be kept confidential and would be used for research purpose only. Numbers were employed to protect the anonymity of the research participants in all transcripts and reports. I respected all my research participants and ensured that they understood their rights regarding anonymity and confidentiality by explaining to them that I would not use their names or the names of the schools in the study.

3.8. Conclusion

In this chapter a qualitative interpretive case study research method was presented which I considered as an umbrella for my study. Three methods of data generation techniques were presented, namely documentary evidence, focus group discussion and observation. The chapter

discussed data analysis and illustrated how the data were reduced, organised in categories and managed. The chapter also discussed the issue of validity and illustrated how triangulation was used to lessen bias in the study. The chapter then explained how the issue of ethics was dealt with to ensure voluntary participation of the participants and to protect their identity.

CHAPTER 4: DATA PRESENTATION

4.1 Introduction

This chapter presents the findings of the data gathered through document analysis, focus group discussion and classroom observations. This data is representative of how environmental problems and problem solving methods are presented in the Namibian Grade 10 Geography syllabus and how these are represented through teachers' intentionality and practice. The data is presented in two sections namely: Summary of lesson planning and implementation (Section 4.2); and cross-case analysis of the presentation and representation of environmental problems and problem solving strategies (Section 4.3).

Section 4.2 of this chapter presents data related to each teacher in two sub-sections. Firstly the summary of lesson planning aimed to give an overview of activities planned by the teachers beforehand. Secondly the section presents the implementation of each lesson plan two from each teacher (Teacher 1, Teacher 2 and Teacher 3) describing the implementation of the lesson plans with emphasis on how teachers represent environment problems and how they mediate problem-solving activities in practice. Section 4.2 draws on the observation data and the lesson plans collected during the observation.

Section 4.3 of this chapter is presented in three sub-sections which are: Presentation and representation of environmental problems (4.3.1) which draws on Analytic Memo 1 (in response to Goal 1 of the study); Teaching Methods (4.3.2) which draws on Analytic Memo 2 (in response to Goal 2 of the study); and Review of problem solving process models (4.3.3) which draws on Analytic Memo 3 (in response to Goal 3 of the study). All the three sub-sections present a cross-case analysis of data from document analysis, the focus group discussion and classroom observations. All raw data are presented in italics.

4.2 Lesson planning and implementation

This section gives a summary of the lesson plans, which teachers used to guide their teaching and learning processes. Two lessons are described for Teacher 1 that is on land pollution and deforestation. One lesson (the same presented to two classes) is described for Teacher 2. This lesson covered the themes of pollution, population and deforestation in one lesson. One lesson (the same is presented for two classes) is described for Teacher 3. This lesson covered one theme namely 'pollution' (see Section 3.4.3 for explanation). The section also presents data generated through observation of lessons. The description presented in this section emphasises how teachers represent environment problems and how they mediate problem-solving activities in practice.

The objectives (what the teacher wants to achieve at the end of the lesson) and basic competencies (what learners ought to be able to demonstrate at the end of the lesson) covered by these teachers during the study were derived from the Geography syllabus. The lesson plans presented in the following sections did not always provide the same amount of detail of the roles of the teachers and learners in the process. For example Teacher 2 and Teacher 3 included a consolidation and reflection part, but Teacher 1 did not.

4.2.1 Teacher 1

The first teacher observed, teaches at a combined school (Grade 1-10), a semi-urban school in Rundu town in the Kavango region. The school has only one Grade 10 class.

This data is presented from the lesson plan and Teacher 1, Observation 1 (T1-Ob1) (see Table 3.1). The lesson was designed to cover the theme of land pollution.

4.2.1.1 Teacher 1: Summary of Lesson 1

The objective of the lesson: Learners should be able to investigate the reasons for the deterioration of the environment and search for possible solutions.

The basic competence: At the end of the lesson learners should be able to describe pollution of land and suggest solutions for the problems.

Introduction of the lesson:

- The teacher introduced the lesson by explaining to the learners what land pollution is.

Development of the lesson:

- The teacher asked learners if the school ground was polluted or not. Learners were asked to give choices for their reasons.
- The teacher discussed with learners what can be done to reduce land pollution

Conclusion of the lesson:

- The teacher encouraged learners to practice problem solving skills.

4.2.1.2 Teacher 1: Implementation of Lesson 1

This teacher started by introducing the theme of the day which was land pollution by writing it on the chalk board. She then defined land pollution as “*when an area is dirty because of the waste that humans are throwing on that specific area. That is what we call land pollution*”. The teacher then asked learners to recall what they saw the day before when they walked around the school premises, that is whether the school ground was polluted or not.



Figure 4.1: Pollution in the school ground

The teacher used the example of pollution in the school ground as the focal point to commence the discussion on the theme of the day (see Figure 4.1). There were contradictory responses among the learners about the school grounds. Some said that it was polluted as indicated below:

- *Looking around there is paper around and there is nothing removed (T1-Ob1-L2).*
- *I just want to add on, the school ground is pollute, because any single paper that you get outside or not put in the....that mean is polluted (T1-Ob1-L3)*

These observations by learners are consistent with Figure 4.1 which shows paper pollution. Another learner had the following response:

- *It is not polluted, because there is only paper around and no waste materials on the ground (T1-Ob1-L1)*

It appears that this learner does not see paper as pollution. The teacher did not query or challenge this understanding and continued to ask learners to mention causes of land pollution. Learners did not hesitate to respond to the question. Learners' responses were:

- *It is when people create unnecessary waste special for packaging (T1-Ob1-L4)*
- *We do not recycle all the waste we create (T1-Ob1-L6)*
- *It also about the number of ignorance (T1-Ob1-L9)*

The teacher asked learners what is meant by "recycling" and allowed a few learners to give their own understanding of the word recycling. Learners' responses clearly indicated that they were familiar with the word recycling. One learner described recycling as "*to reuse something else in a new form*" (L7). Learners also mentioned some of the causes of land pollution. The teacher then added some of the causes that were not mentioned by learners, but she did not explain these: "*Now to add on agriculture also can cause land pollution*".

The teacher then asked learners to mention the effects of land pollution on the environment. The responses given by learners were:

- *Pollution can cause the extinction of species (T1-Ob1-L12)*
- *It cause diseases (T1-Ob1-L2)*
- *It can injury something like broken bottles (T1-Ob1-L14)*

- *Plastics can cause death of animals, if it happens to swallow it (T1-Ob1-L15)*
- *It can also...prevent tourists (T1-Ob1-L18)*

The teacher then asked learners to explain what they mentioned. After that the teacher summarised all the answers given by the learners. She then asked learners to suggest some possible solutions to some of the problems they mentioned. Learners came up with some ideas on what people should do in order for them to reduce land pollution. Suggested solutions given by learners were:

- *Make use of the dust bins (T1-Ob1-L19)*
- *Recycle (T1-Ob1-L20)*
- *Educate people about disadvantages of pollution (T1-Ob1-L24)*
- *Burying (T1-Ob1-L32) and*
- *Burning (T1-Ob1-L33)*

From the above possible solutions suggested by learners the teacher highlighted the complexities of environmental concerns regarding the disadvantages of burying and burning as possible solutions. She told learners that neither burying nor burning would solve the problem of land pollution, but would result in other environmental effects. She further said that people need to look at activities that will reduce land pollution, but not to create other environmental problems. The teacher then concluded the lesson by summarising the main points of the theme which were; causes and effects of land pollution and possible solutions.

4.2.1.3 Teacher 1: Summary of Lesson Plan 2

This data and data in 4.2.1.4 is presented from the lesson plan and Teacher 1, Observation 2 (T1-Ob2) (see Table 3.1). The teacher planned a second lesson on the ecology topic. This time she covered the theme of deforestation.

- **The objective of the lesson:** Learners should be able to investigate the reasons for the deterioration of the environment and search for possible solutions.
- **The basic competence of the lesson:** At the end of the lesson learners should be able to describe farming methods as a cause of deforestation.

Introduction

- The teacher asked learners to define the term deforestation and list the causes of deforestation

Development of the lesson

- Teacher explained to the learners how different farming methods cause deforestation as well as problems caused by deforestation.
- Teacher asked learners what can be done to solve the problem of deforestation

Conclusion of the lesson

- The teacher summarised the lesson.

4.2.1.4 Teacher 1: Implementation of Lesson Plan 2

The teacher started the lesson by writing the term deforestation on the chalk board and defining it for the learners. She said that “*deforestation is the cutting down of trees without replacing them*”.



Figure 4.2: The teacher introducing deforestation to learners

She then asked learners to mention the importance of trees in their lives. These were the responses given by learners:

- *It produces shadow (T1-Ob2-L1),*
- *It releases oxygen that we use for breathing (T1-Ob2-L2),*
- *It provides fruits (T1-Ob2-L3)*
- *It provides medicine (T1-Ob2-L4)*
- *Use for building our home (T1-Ob2-L5)*

The teacher summarised all points that were mentioned and at the same time she asked learners to mention the cause of deforestation. Learners mentioned the causes of deforestation; *building houses, agricultural activities and firewood*. The teacher asked some learners to explain points that they mentioned. For example one learner explained how agriculture causes deforestation, because: *As the population growing everybody wants to be with his/her own land so they clear a large land for agriculture activity (T1-Ob2-L9).*

The teacher led the learners step-by-step with questions about the importance of trees, to causes of deforestation and to actions which people should take to reduce deforestation. Learners struggled to find suggestions of what people should do to reduce deforestation. In cases where learners mentioned, but could not explain their own points the teacher helped learners to explain this to others through questioning them.

The teacher kept on reminding learners about those people who cannot afford alternative sources of energy, that they can continue to use trees as one of the sources of energy, but they should replant some trees for future use. She then asked learners to mention any environmental problems caused by deforestation, if people cannot practice activities that could reduce deforestation. These were the responses from the learners:

- *Loss of nature (T1-Ob2-L24),*
- *Soil erosion (T1-Ob2-28) and*
- *Increase carbon dioxide in the atmosphere (T1-Ob2-L29)*

The teacher then consolidated the lesson by summarizing the points that learners mentioned. The teacher gave a summary note for the lesson presented to learners.

4.2.2 Teacher 2

Teacher 2 teaches at a suburban school which is located in Rundu town in the Kavango region. It is a combined school which teaches from Grade 1-10. The school has five Grade 10 classes and the numbers of learners in each Grade 10 classes are 55 and above. This teacher designed one lesson plan which was implemented in two classes. The teacher planned a lesson on the ecology topic of the syllabus and the lesson was designed to cover the themes of pollution, population and deforestation.

This sub-section presents data generated from Teacher 2's lesson plan. It also covers the teacher and learner actions during the implementation of the lesson plan which was presented to two classes. Note that this teacher implemented the same lesson plan in two classes. This data is presented from Teacher 2 observations 1 and 2 representing the two classes respectively (T2-Ob1 & T2-Ob2) (see Table 3.1).

4.2.2.1 Teacher 2: Summary of Lesson Plan 1

- **The objective of the lesson:** The teacher did not write anything on the objective of the lesson
- **The basic competence of the lesson:** Learners should be able to name three types of pollution and explain air pollution.

Introduction of the lesson:

- The teacher asked learners to mention types of pollution they have studied

Development of the lesson:

- Teacher distributed worksheets to the learners and instructs them to answer the questions on the worksheet (See Appendix 6)
- The teacher also indicated that he would discuss answers from learners and give them correct answers

Conclusion of the lesson:

- Teacher summarised the main points of the lesson

4.2.2.2 Teacher 2: Implementation of Lesson Plan 1

The data of this lesson from two classes were both presented here, since there was no significant difference between these two sets of data. In both classes the teacher asked learners questions on the themes of pollution (air, water and land) and deforestation which they did as an introduction to the activity. He then instructed learners to sit in pairs to receive the worksheets prepared by him. He gave learners ten minutes to use the pictures on the worksheet to help them to answer a series of questions (See Appendix 8). The questions which related to the pictures on the worksheet were:

- *What do you understand by the term population explosion*
- *State four negative effects of rapid population growth on the natural environment as shown in Figure 4*
- *Suggest two possible solutions to overcome the huge growth of population in the world*
- *Identify from the diagram three purposes for which water from the river is used*
- *Suggest two ways on how the people living in the village along the Kavango river [would] use water in order to avoid water pollution*
- *Identify the cause of deforestation*
- *Suggest two solutions to this specific problem*

Additional instructions were also given to the learners not to open their summary books or textbooks and to raise their hands for help if they were struggling with any question.

After receiving instructions learners started to raise their hands to call for help. Many times when the teacher was called to help learners with some questions that were challenging, he asked learners leading questions and gave them some examples to help them get the answers.

By helping learners the teacher noted that there was one question that was posing a problem to the learners because of one word which learners were struggling to understand (this challenge was observed in both classes). The word “*rapid*” was a problem to them, and in both classes the teacher gave the meaning of the word. He explained that “*the question said ‘State four negative*

effects of the rapid population growth on the environment as shown in Figure 4'. Okay this word rapid means fast. When people are increasing very fast what problems do they cause on the environment? But you must use the figure given to you". Learners started working with more confidence on the question after receiving help.

After completing the activity learners were asked to exchange their work. The teacher read the questions for the first picture which were based on the effects of population explosion on the environment and asked pairs to read the answers of their peers.

In both classes firstly, he asked learners to define population explosion. Examples of the definitions provided by learners from both classes are listed below:

- *When the environment is been polluted by human and their activities"*
- *When the population increase*
- *When people are overcrowded*
- *When many people live in a country*
- *When people are more than resources*
- *Total amount of people living in a country*
- *The rapid uncontrolled increase of the world*

He then gave learners the meaning of population explosion, he said that *"is the fast/rapid or sudden/uncontrolled increase of the population in the world"*. Secondly, he asked learners to state four negative effects of rapid population growth on the environment. Listed below are the answers that were given to the question by learners in both classes:

- *Soil erosion, deforestation and depletion of natural resources*
- *Overgrazing, overcrowding and bush encroachment*
- *Air pollution and water pollution*
- *People will get diseases*
- *Littering and desertification*

The teacher drew on the learners' answers to summarise and elaborate with evidence from the pictures that he gave to learners as a learning support material. He then asked learners to suggest possible solutions to overcome the problem of rapid population growth.

These were answers given by learners from both classes:

- *Family planning*
- *Educate people about the danger of overpopulation*
- *Later marriage*
- *Have one child*
- *Contraceptive reduce and*
- *Reduce the number of population*

Moving from the theme of population to that of pollution, the teacher asked the learners to indicate what problems were identified associated with water supply in rural areas. He then asked them to identify three uses of river water. The learners in both classes gave the following answers:

- *Washing dishes*
- *Fetching water*
- *Bathing and washing clothes*

The teacher then asked learners to come up with possible solutions to the problem. The examples of the solutions mentioned by learners were:

- *People must not wash in the river*
- *Provide tank for animals*
- *Tell people to stop throwing rubbish in the river*
- *People must use big plate to bath*
- *They must stop washing dishes in the river*
- *People must use public toilets at the villages*

The teacher probed the learners regarding these solutions. For example he asked learners to suggest an alternative if “people must not wash in the river” by stating: “*to avoid, but still not clear to me, specify what we could do now if we are to avoid*”. This helped pair 17 in the first class to elaborate that: “*people must not wash in the river, but bucket*”.

Moving on to a third theme in the lesson the teacher used the third picture which focused on deforestation. He asked the learners to define what deforestation is. Pair 4 in the first class and Pair 18 in the second class said that: “*the cutting down of trees without replacing them*”. The teacher asked learners to identify the cause of deforestation on the figure: “*building materials*” was mentioned from both classes. He also asked learners to suggest possible solutions to the problem both classes mentioned: “*use bricks*”.

The teacher then consolidated the lesson by summarizing the points that learners mentioned.

4.2.3 Teacher 3

This teacher teaches at a secondary school located in the centre of Rundu town. The school has four Grade 10 classes and the numbers of learners in each Grade 10 classes are 30 and above.

This sub-section presents data generated from Teacher 3’s lesson plan. It also presents the teacher and learner interactions during the implementation of the lesson plans. Teacher 3 also designed one lesson plan for two Grade 10 classes.

This data is presented from the lesson plan and Teacher 3, Observation 1 and 2 (T3-Ob1 & T3-Ob2) (see Table 3.1). The teacher designed the lesson to cover the ecology topic, specifying the theme of pollution (air).

4.2.3.1 Teacher 3: Summary of Lesson Plan 1

- **The objective of the lesson:** learners should be able to investigate the reasons for the deterioration of the environment and search for possible solutions.
- **The basic competencies of the lesson:** At the end of the lesson learners should be able to:
 - Define pollution

- Explain the problems of land, water and air pollution
- Suggest solutions to these problems

Introduction of the lesson:

- The teacher introduced the lesson explaining to the learners the damage done to the environment by overpopulation.

Development of the lesson:

- The teacher asked learners to answering the following questions:
 - Explain the term pollution
 - Describe problems caused by pollution
 - Describe possible solutions to pollution

Conclusion of the lesson:

The teacher summarised the lesson

4.2.3.2 Teacher 3: Implementation of Lesson Plan 1

The data of this lesson from two classes were combined since there was no significant difference between the two classes. In both classes the teacher started the lesson by telling learners the theme of the day which was pollution. He then asked learners to mention different types of pollution they had come across or had learned answered:

- *Air pollution*
- *Water pollution*
- *Land pollution*

He then asked the learners to define pollution. The following answers were given:

- *Any human activity that cause poison to land, under water and air*
- *When land or water is polluted by human activities*
- *Human activities poisoning the water, land and air*

He used the picture of Van Eck power station (electrical coal power station) found in Windhoek to help learners to mention sources of air pollution.



Figure 4.5: The Van Eck power station

The answers of sources for pollution given by learners were:

- *Burning fossil fuel*
- *Car exhausts*
- *Use of chemical in the farm*

The teacher consolidated the points mentioned by learners.

In both classes he asked learners what would be done to reduce the problem of air pollution. The learners mentioned that people should use alternative energy sources. The teacher then asked learners to mention different kinds of alternative energy sources, learners answered:

- *Solar power*
- *Wind power and*
- *Hydro-electric power*

He then asked them to mention environmental problems caused by air pollution. The environmental problems given by the learners in both classes were:

- *The more gas emitted in atmosphere can destroy ozone layer and it will cause ultra violet (UV)*
- *When greenhouse gases go in to the atmosphere it causes global warming*

- *It will cause acid rain*

In both classes the teacher asked learners to mention greenhouse gas that destroy the ozone layer.

Learners mentioned:

- *Carbon dioxide*
- *Carbon monoxide*
- *Methane*
- *Sulphur oxide*
- *Carbon oxide and*
- *CFC*

The teacher did not highlight explicitly to the learners that from the list they mentioned only CFC is responsible for destroying the ozone layer. The teachers further asked learners to mention the sources of CFC, learners' answers were:

- *Refrigerator*
- *Spray and*
- *Air conditioner*

He drew a diagram on the chalk board in both classes to explain how greenhouse gases lead to global warming (See Figure 4.4).



Figure 4.4: Teacher presenting a diagram of global warming

He asked learners to define global warming and this definition was given: “*the increase in average temperature in the atmosphere, which can affect the climate*”. He asked learners to give the effects of global warming on the environment. Below are the responses from learners:

- *It will cause flood*
- *It will reduce food production*
- *It will increase malaria*
- *Will cause climate change and climate change will cause drought*

He concluded the lesson by summarizing the main points of the topic.

Section 4.3 Cross-case analysis of environmental problems and problem solving

This section was constructed through a cross-case analysis of the three cases presented above as well as additional data from the syllabus document analysis and focus group discussion. The analysis is a construction of how environmental problems and problem solving methods are presented in the syllabus and how these are represented and implemented through teachers’ intentionality and practice. Information is presented in three main categories which are:

Presentation of environmental problems (4.3.1); Teaching methods (4.3.2); and Expanded enquiry-based learning model (4.3.3).

The categories for the analytic memos were directly related to the literature presented in Chapter 2. The literature helped in developing sub-categories. The sub-headings used under section 4.3.1 and the structure of Analytic Memo 1 were derived from Beck's (1992) thesis of risk society (Section 2.8). The sub-headings used under section 4.3.2 and the structure of Analytic Memo 2 were derived from Rosenberg et al., (2008 - Section 2.4). Section 4.4.3 uses the expanded version of Murray's enquiry-based learning model (2005) to reflect on problem-solving processes in Geography classroom. This final section draws on Analytic Memo 3 and relates to research Goal 3.

4.3.1 Presentation and representation of environmental problems

The data represented here was drawn from Analytic Memo 1 (See Appendix 4). This data is presented according to three characteristics of environmental problems in relation to Beck's (1992) thesis of risk society: 1) Environmental problems as socio-ecologically related, 2) Environmental problems presented using social and scientific rationality and 3) Environmental problems presented as cross border problems. These three characteristics were used to reflect on the syllabus and focus group discussion. These characteristics were also used to describe how teachers represent environmental problems in the schools that were observed.

4.3.1.1 Environmental risks and problems presented as socio-ecological relationship

Beck (1992) in his thesis of risk society explains that risks do not only affect the ecological sphere, but also the social, political and economic spheres.

The syllabus identifies socio-ecologically related issues as one of the focus areas to work with in order to understand environmental problems. This is evident in the statement that Geography should “*examine the interdependent relationship between humans and nature that is under threat from human activities*” (GS, 2008, p. 1). The syllabus also suggests that “*Geography provides learners with an understanding about the political, social, economic and biophysical*

dimensions of the world that will enable them to operate effectively in their society and the environment as responsible members of the community” (ibid, 2008, p 2).

Evidence of an understanding of environmental problems as socio-ecological was presented when teachers highlighted a connection between socio-ecological issues such as; poverty, water pollution, deforestation and inflation. This was evident firstly, during the focus group discussion when Teacher 1 pointed out that unemployment is the root cause of many environmental problems in Namibia. Teacher 1 explained that people depend on the environment to survive, some directly and some indirectly. As a result they destroy the environment which causes certain environmental problems such as deforestation and desertification. She indicated that lack of resources due to high population growth has forced people to use limited resources to meet their basic needs. She gave the following example, *“population also contributes to environmental problems. If you look now at over-population, means that people there will use much of the land in order for them to settle or to cultivate so it will cause problems to the environment” (FT1).* Teacher 1 also observed that some people still *“blindly defend”* their tradition by cutting down trees to make hedges around their houses. She pointed out that *“their reasons being that they are preserving their tradition, but in fact poverty is the main factor behind all these activities”*. Similarly, Teacher 2 connected water pollution with poverty. He said that poverty and a high cost of living is forcing poor people who live in Rundu town to use the river for bathing, washing their belongings and as well as for fetching drinking water.

During lesson plan implementation Teacher 1 and Teacher 2 presented environmental problems as socio-ecological problems. In her second lesson, Teacher 1 explained to learners that *“if we cut down most of the trees...and we know that some of trees provide medicine. If it gets extinct at that specific area then we are going to lose that specific medicine in our area, unless we go to the next village or we travel a certain distance in order to get those tree and take it to make medicine (T1-Ob2).* She also noted that because of *“food insecurity”* trees are cut down to make *mahangu* (millet) fields. Since agriculture is the backbone of the economy in Namibia this exacerbates deforestation in our country. She further pointed to other human activities such as: burning of trees to make charcoal for commercial use, logging of trees for furniture, road construction and construction of stadia aggravate the process of deforestation. She further

related the following socio-ecological issues to explain the effort of the Namibian government in trying to combat illegal cutting down of trees. She said that:

“The government has made the buyers and sellers of tropical wood illegal, meaning now those one [people] who like cutting down trees in order for them to sell, it is now illegal. We know that some people depend on cutting down trees in order for them to get income. The government has put up committees in different villages in order to limit the number of trees that people cut down and then they can be able to have licence or permission in order for them to cut down certain number of trees, this will to reduce deforestation that we are having in our area” (T1-Ob2).

In addition, in her first lesson Teacher 1 said that mining as one of the sectors of the Namibian economy contributes to environmental problems, by depositing waste materials on the land which are no longer needed (T1-Ob1). She also pointed out a further socio-ecological relationship when she argued that when the environment is dirty it is likely that fewer tourists will visit the country and this will affect the economy of the country in a negative way (T1-Ob1).

Teacher 2 in both lessons discussed the socio-ecological nature of issues when he asked learners to define population explosion and give effects of rapid population growth on the environment. The following environmental effects were mentioned by the learners; *“soil erosion, deforestation, depletion of natural resources, overgrazing, overcrowding and bush encroachment, littering and desertification”*, he did not explain these further. He also asked learners in his lessons to define deforestation. Pair 4 in the first class and Pair 18 in the second class said *“the cutting down of trees without replacing them”*. He further asked learners to identify the cause of deforestation in worksheet. The following answer was mentioned by learners *“building materials”*.

4.3.1.2 Both social and scientific rationality could be strengthened in classroom practice

Beck’s thesis of risk society argues that in the past there were splits and gaps between scientific and social rationality in understanding environmental problems (Section 2.8.2). In his thesis of risk society Beck (1992, Section 2.8.2) argues that risks in modern society need both scientific and social knowledge to be understood by people, since those risks are no more defined by scientific reasoning alone, but also by societal experiences.

The syllabus does encourage society's voice and experiences in understanding environmental problems. This is evident in the statement that Geography teachers "*should use local examples to illustrate geographical concepts, issues and process. Case studies on local issues related to syllabus's geographical concepts, issues and strategies can be adapted to appropriate level of learners. Local case studies expose learners to examples of real life problems and helps learners to examine and analyse real life situation*" (GS, p.3). The syllabus also encourages "*Geography teachers to provide scientific knowledge about human processes to understand environmental problems*" (ibid, p.1).

The focus group discussion gave insight into using scientific rationality to discuss environmental problems. Teacher 1 mentioned that it is always challenging to explain some of environmental problems to learners which require a language of science to make learners understand it better. For example Teacher 1 said that she always faces a challenge when teaching global warming to learners particularly as this topic requires a scientific explanation of the phenomenon.

Scientific rationality was employed by Teacher 3, when he presented a theme on pollution (air). He pointed out that "*more gas emitted in atmosphere can destroy ozone layer and it will cause ultra violet*" (T3-Ob 1 & 2). In both of his lesson presentations Teacher 3 asked learners to mention one of the gases that destroy the ozone layer and "*chlorofluorocarbon*" (CFC) was one of the gases mentioned by learners. Additionally (and inaccurately) some of the greenhouse gases were also mentioned; "*sulphur oxide, methane, nitrogen oxide, carbon monoxide and carbon dioxide*". Teacher 3 further asked learners to mention the sources of CFC. The following sources were given by the learners; "*refrigerator, spray, air conditioner and food package*". In addition he reminded learners that "*we are still on the problem of CFC, what environmental problems does CFC will bring in the atmosphere*". Learner 20 answered that "*when greenhouse gases go in to the atmosphere it causes global warming*". This dialogue indicates some conflation between ozone depletion and global warming as no clear distinction was made between the two.

In the presentation of both lessons 1 and 2, Teacher 3 drew a simple sketch on the chalk board to explain how global warming results from human activities that take place on the earth which

emit gases such as sulphur oxide, methane, nitrogen oxide, carbon monoxide, carbon dioxide and CFC in atmosphere. He explained the formation of a greenhouse blanket that is caused by the build-up of a greenhouse gases in the atmosphere which trap the long wave radiation from the sun. He further said that: *“once the heat is trapped it will be kept between the earth surface and the atmosphere and the temperature in the atmosphere will increase and this is what the scientists call global warming”*. He further explained how global warming can result in coastal flooding; he said that *“global warming still has further effect on the environment. What happens is that when the temperature in the atmosphere increases worldwide, the ice at the pole region melts. As it will start melting the water will flow in the ocean, the water in the ocean will rise and coastal towns are likely to be flooded”*.

In addition Teacher 2 in the focus group discussion stated that some scientific explanations are problematic because they cannot relate to them directly through experience. *“When we talk about global warming and ozone layer you just talk it in general but you cannot show it to the learners in reality”* (FT2).

Teacher 1 used scientific rationality to help learners to assess environmental problems. In her first lesson She explained to the learners how chemicals from mining can cause land pollution. She further explained to the learners how agriculture activities cause land pollution. In her explanation she said that:

“Now to add on again...agriculture also can cause land pollution. Now how does agriculture cause land pollution? We use now different types of chemical, sometimes in order for us to kill pest not to destroy our crop. Now some of the pesticide that we use destroy the nature of the soil, that one also we call it land pollution” (T1-Ob1).

She then mentioned pesticides as one of the chemicals used in agriculture which can cause fish to die once washed into the river by rain. She said that this problem has a further effect on *“people who eat these fish”*. She indicated in her teaching that *“human beings need some scientific knowledge to understand how some chemical which they use in other parts of their life end up causing another effects in other form of life”* (T1-Ob2).

Teacher 2 in his lessons explained that *“when people are overcrowded they contribute carbon dioxide”*, but he did not explain further how this happens. Moreover, in his lessons, Teacher 2 asked learners *“when we have more carbon dioxide in the atmosphere it will cause what or it will lead to...?”* One learner answered that *“it will lead to global warming”*. The teacher did not ask the learner to explain how. He further mentioned that due to overpopulation *“they [people] are using soap to wash [their clothes] in the river and soap contain some chemical, as a result of water pollution fish in the river there will die. Even when you drink that contaminated water you will become sick”* (T2-Ob1). The details of these cause/effect relations were not elaborated.

Teacher 3 discussed environmental problems using scientific rationality. In his lessons, he said that people emit air pollution by burning fossil fuel for cooking and by using cars for travelling. In both lesson presentations he asked learners *“do you know that the chemical called herbicide that farmers use to kill weed, are the same chemical that cause air pollution”*. He also explained how human activities cause acid rain. To illustrate this he said that: *Whatever we are doing here that emit nitrogen oxide, sulphur oxide and carbon monoxide in the atmosphere. What happen these gases react with sunlight and combine with rain water and cause acid rain, which can affect things like fish in the water and plants in the water* (T3-Ob1 & 2).

Section 2.8.2 highlights Beck’s argument that risk should be defined not only by scientific reasoning, but also by ‘society experience’. In a focus group discussion Teacher 1 explained how sometimes she gives learners a topic that she will be teaching the following day and sends them to do a mini-research project in their communities to find out exactly how people in the community are experiencing and responding to the problem and to get their views on how to reduce the problem.

Across the different cases, the socio-ecological nature of environmental issues highlighted the relationship between deforestation and lack of resources to meet basic needs (Section 4.3.1.1), however these were not elaborated in terms of specific experiences, communities and Namibian context thus not emphasising social rationality.

4.3.1.3 Environmental problem presented as local and cross border problems

A further characteristic of Beck's thesis of risk society is an understanding that risk has changed from a local issue to a cross border concern which often affects the global village (see Section 2.8.3). Beck (1992) states that risks are no longer tied to their place of origin therefore this needs people to discuss risk as an international concern as well as a local concern.

The Grade 10 Geography syllabus states that Geography should provide learners with the skills and competencies which will help learners to understand that local environmental issues have global effects. The syllabus further states that "*Geography should help learners to understand how these risks and challenges can be addressed at national and global level*" (GS, p. 4). Evidence of understanding environmental problems as local risk was presented when Teacher 1 asked learners to mention the effects of land pollution. The following local environmental effects were mentioned; "*pollution can cause the extinction of species. It cause disease. It can cause injury something like broken bottles, plastics can cause death of animals, if it happens to swallow it and it can also dirty things again can prevent tourists*".

There was nothing explicitly mentioned about environmental problems as cross borders problems during the focus group discussion, but evidence of an understanding of the cross-border nature of environmental issues was discussed implicitly in classroom implementations as evident in the examples below;

Teacher 1 discussed "extinction of species" and "loss of nature" from pollution which implies pollution from one place affecting another place. Teacher 3 said that "*climate change is one of the effects of global warming and climate change can result in severe drought which will affect food production*" (T3-Ob1). He also explained that melting ice in polar regions caused by climate change, could result in floods on the coastal regions. He said that "*as a result of increasing temperature in the atmosphere that result in climate change, ice at the polar regions is likely to melt down and flow in the ocean, when the ocean rise all coastal towns worldwide are likely to be flooded*" (T3-Ob1&2). Teacher 3's discussion of ozone layer depletion and acid rain

are more examples of cross-border effects of pollution, although not highlighted specifically as cross-border by the teacher.

4.3.2 Teaching Methods

This section presents data gathered from the document analysis of the syllabus, the focus group discussion and teachers' lesson implementations. The data describing teaching methods used in teaching the environmental problems and problem solving is a response to Research Goal 2. This data was analysed using descriptions by Rosenberg, O'Donoghue and Olvitt (2008) (Section 2.4) of a selection of different teaching method and processes in environmental education, namely which are;

- Relating to prior knowledge and live experience
- Field based method
- Literature research
- Guided questioning
- Demonstrations and experiments

4.3.2.1 Relating to prior knowledge and lived experience

The syllabus states that the starting point for teaching and learning should be learners' prior knowledge and experiences (GS, p. 6). It further says that the learning processes in schools should include building and challenging learners' prior knowledge and their experiences which allow them to extend their thinking (GS, p. 6). The syllabus also encourages teachers to use their local environment and learners' prior knowledge when planning for simple projects which will promote the development of geographical skills (GS, p.3).

In the lesson implementation the mobilisation of prior knowledge and lived experiences was one of the teaching methods teachers used to explain and clarify terms and concepts for environmental problems to learners. Teacher 1 illustrated land pollution through this statement: *“Now I gave you an example that side when you look outside, you can see that there are paper*

and plastics that you can find on the ground, that one automatically we are going to call it as land pollution” (T1-Ob1). After she gave them an example of the school, she asked learners to mention who pollutes the school ground. Learners answered; *“It is learners and teachers”*. In addition she gave them an example of bottles that people throw away anyway as one cause of land pollution. In the same lesson she related learners’ lived experiences to some rich people who throw away their old clothes instead of giving them to the poor people to reduce land pollution. In her second lesson presentation Teacher 1 related learners’ lived experiences to the cutting down of trees for charcoal and furniture such as chairs, desks and tables as causes of deforestation (T1-Ob2).

She also related learners lived experiences to the way rural people in the Kavango region keep seeds in bottles as one way of reducing land pollution. The teacher did not explain further on how these practices reduce land pollution. A nearby village was also used by Teacher 1 in lesson presentation 2 to relate deforestation to learners’ lived experiences. Teacher 3 related learners’ lived experiences by referring to the teachers at his school, many of whom come to school using their own cars to explain emission of carbon dioxide in the atmosphere. In both lesson presentations Teacher 3 also asked learners to mention types of pollution that they knew.

During the focus group discussion Teacher 2 pointed out that *“teachers always find it easy to relate their lessons to learners’ experiences when they are teaching theme like deforestation, because these learners and their parents is what they do to cut down for firewood and building materials learners will draw from their experiences to understand what is going on” (FT2).*

In addition, during lesson implementations, teachers used learners’ prior knowledge and lived experience during their introductions to clarify meanings of environmental concepts and situations.

4.3.2.2 Field based method

The syllabus promotes skills such as observation, investigating, collecting, analysing, interpreting data and developing skills in learners (GS, p. 2). These skills are important for conducting field work when teaching Geography. The syllabus states that teaching should

involve learners in finding their own ways through investigation of a topic and area of concern (GS, p. 2).

In the focus group discussion, Teacher 1 said that field based work is a good teaching method, because it engages learners in real life situations which will promote their understanding (FT1). She highlighted that such fieldwork can be done by arranging afternoon classes with learners to come and conduct fieldwork.

In addition Teacher 2 pointed out that the Grade 10 Geography syllabus suggests that learners do fieldwork (a transect study) for 10-15 minutes in order to compare plants that grow in certain areas. He said that often he sends learners to do research of one of the environmental problems. He then asks learners to present their findings in the class and invites other learners to comment on the findings.

Contrarily, Teacher 1 pointed out many teachers do not engage learners in field-based learning, but only talk about environmental problems that learners are facing. There was no fieldwork used in any of the lessons observed for this study.

4.3.2.3 Literature research

The Geography syllabus states that teaching and learning processes should allow learners to “*discover and explore information for themselves*” (GS, p. 6). In a focus group Teacher 1 said that she uses a literature research method when she asks learners to go through textbooks to read and find out some solutions to the environmental problems being studied. However, a literature research teaching method was not included (none of the teachers used a textbook either) in any of the teachers’ lesson plans observed for this study, with most of the emphasis on prior knowledge.

4.3.2.4 Guided questioning

In the focus group discussion Teacher 1 described a process of guided questioning that she uses in teaching. As an example she said that first she defines the term ecology and then asks learners the importance of environment in their lives. She then asks learners to mention changes they

observed in the environment after interacting with it. She added that she directs learners' answers by asking them guiding questions that help them to give a satisfactory answer. She also explained that teachers use a guided questioning teaching method to try to direct learners to a solution and see if learners have any ideas on how to solve such environmental problems. Similarly, Teacher 2 mentioned that he uses guiding questions during a lesson introduction and in the development of the lesson to guide learners to the right answers or solutions. He then added that teachers probe learners to see if they can explain important lesson concepts.

This strategy was used by all three teachers during their lesson presentations. This is illustrated by the following data gathered during the lesson presentations. Here are examples of how Teacher 1 used guided a questioning teaching method during her lesson presentation (T1-Ob1):

Teacher 1-Example of guided questioning

T1: What will you do so that your land can not be dirty?

Learners: Let the polluters pay

T1: After paying are you not going to cause any pollution?

Learners: Recycle it

T1: But we know 100% that some of the products we do not recycle it. Where we are going to put it not to cause land pollution? We said here we are looking on a solution on how we can reduce land pollution. We are saying recycle and reuse, but some products we cannot recycle and cannot reuse them. How about such products?

L33: I think they forgot about burning

T1-Ob1: If we burn we will cause air pollution and if we bury it on our sounding we will cause land pollution

Learners: Underground

T1: Underground is also the land

L34: If we can just collect materials that cannot be recycle and put them on the same place and pick them. At least only that place will be polluted, but the other site where you collected it will be clean. Instead of leaving them around all over it will not attract flies and mosquitoes as we said, but if you collect and put them at one place at least you are reducing some.

T1: That is what we said. Now we are going to collect all those waste and put them in a car and go dump them somewhere. Okay here we got a dumping side up there, even though it's going to cause land pollution, but at least the area close by the people is clean. It is only that specific area going to be polluted and land pollution will be reduced.

The teacher did probe further on a significant point made by the learner that pollution is reduced to one place.

In the second lesson presentation Teacher 1 asked learners to mention the causes of deforestation. She instructed learners to imagine the importance of trees and how the use of trees for these purposes had the potential to cause deforestation. When one learner mentioned agriculture activity as one cause of deforestation, she asked the learner *“How can agriculture activity cause deforestation?”* The learner answered that: *“As the population is growing everybody wants to be with his/her own land so they clear a large land for agriculture activity”* (L9). She then gave her explanation to support the learner’s answer saying that *“People mostly, in developing countries depend direct on doing agriculture in order for them to feed their families, so most of the people clear the land in order for them to cultivate their crops. As a result trees won’t be there. That will contribute to deforestation”* (T1-Ob2).

Added to this she also guided one learner who said *“no idea”* when she asked him to suggest a solution for deforestation. To illustrate this she said that *“let me give you one point. We said that the cause of deforestation can also be when we cut down trees in order to make firewood. Now for you not to cut down trees to make firewood, what else can you use for you not to cut down trees and use it as firewood anything you can use? What will be your solution at that specific point? Instead for you using firewood what else can you use”* (T1-Ob2). Learner 17 answered that one could use electricity. The teacher did probe this learner further to promote critical reflection.

Teacher 2-Example of guided questioning

In both lesson presentations, Teacher 2 used a guided questioning teaching method to help learners arrive at correct answers. Below are examples to illustrate this:

T2: *Alright the next question now. Suggest two ways how people living in the villages alongside Kavango River could use water in order to avoid water pollution? So what can you advise the people to do in this case? These parents do not know this [effect of water pollution] and you from school you know you are studying a lot of things.*

P17: *Avoid washing in the river.*

T2: *Avoid, but still not clear to me. What we could do now if we are to avoid?*

P17: *People must not wash in the river, but must use buckets.*

Teacher 3-Example of guided questioning

T3: *We are still on the problem of CFC. What are the problems?*

L20: *When greenhouse gases goes in to the atmosphere it cause global warming*

T3: *It causes global warming, how does it happen?*

L20: *When the sun heat the ground, the ground will reflect the heat and this incoming heat some will be trapped by greenhouse gases. Then it will cause global warming*

T3: *Very good that is one of the effects. It causes global warming. By the way you must know the greenhouse gases*

The teacher followed by asking the learners to mention the other greenhouse gases.

4.3.2.5 Demonstrations and experiments teaching methods

The syllabus aims to promote skills such as; measurement, location, identify, build, act out, draw, dramatise and demonstration in environmental education lessons (GS, p. 2). In the focus group discussion Teacher 2 described some cases where he used demonstration as a teaching method. He remembered one day he taught air pollution. He explained how he had burned the piece of paper in front of the learners to illustrate air pollution by burning, and then learners suggested that burying piece of paper would be a better solution than burning. No demonstration or experiment teaching methods were observed in the six lesson presentations.

4.3.3 Extended enquiry-based problem solving model

This section is a further response to Goal 3. In this section an extended enquiry-based model created by an amalgamation of problem-solving models (Section 2.7), is used to analyse the

process used by teachers to develop problem-solving skills in learners. The extended enquiry-based model used in this analysis had seven steps. Step four of the Murray model was split in to two (finding possible solutions and taking action) (See Figure 2.1). Step four of the future problem solving model evaluating was also added (see Table 2.2). Thus the steps of the extended model are:

- Identifying the issues and sharing ideas
- Planning and researching (investigating the problem)
- Analysing and presenting the information
- Finding possible solutions
- Evaluating
- Taking action
- Did it work? Change or identify new problem and repeat the process

The following section presents data from analytic Memo 3 (Appendix 6) which analyses problem-solving teaching processes across different environmental topics in relation to the seven amalgamated steps for problem solving. The different topics were the different themes covered by the three teachers (see Table 3.1). The analysis entails both a vertical and a horizontal analysis of the data. The vertical analysis considers the prevalence of different problem solving steps across the topics, while the horizontal analysis considers how teachers presented each topic using the seven problem solving steps.

Vertical analysis: In all six lesson presentations Step 3 (analysing and presenting the information) and Step 4 (finding possible solutions) were the dominant steps in the problem solving process. In all lessons observed the teachers identified the environmental cases which is Step 1 for problem solving process. On the other hand, Step 2 (planning and researching/investigating) and Step 5 (Taking action) were not used in presenting environmental problems. Step 6 (Did it work? Change or identify new problem and repeat the process) was implicitly presented in the problem solving process (see Appendix 6).

Horizontal analysis: With respect to horizontal analysis there were many similarities in the way teachers presented environmental issues which are summarized in the table form (see Appendix 6). This was evident in that in all six lesson presentations, teachers used a linear process of cause, effect and solution to address environmental problems. The differences were that for some environmental issues the teachers appeared to have more knowledge on how to address these. This was evident in the case of land pollution, deforestation and water pollution. For some environmental issues the teachers lacked scientific knowledge on how to explain the issues to the learners. This was evident, for example, in the case of overpopulation where the teacher did not explain to the learners how rapid population growth causes air pollution. In another case (of air pollution) the teacher did not explain to the learners that not all the greenhouse gases destroy the ozone layer, but only CFCs.

4.4 Conclusion

This chapter has shown the ways that environmental problems and problem solving teaching methods are presented in the syllabus and how are these represented and implemented through teacher intentionality and practice. The chapter discussed teachers' lesson presentations and illustrated how teachers implement environmental problems in their classrooms. Through the data presentation, this chapter found that the complexity of environmental issues is highlighted at varying degrees of depth in the syllabus and in teachers intentionality and practice. The chapter also revealed that teachers were using limited teaching methods to support learners' understand of environmental problems. The chapter also revealed that all teachers used a limited of number of steps for problem solving to address environmental concerns.

The next chapter analyses and further discusses the data generated in relation to the literature review presented in Chapter 2.

CHAPTER 5: ENVIRONMENTAL PROBLEMS AND PROBLEM SOLVING STRATEGIES AND PROCESSES

5.1 Introduction

This chapter discusses the presentation of environmental problems and problem-solving methods and processes in the Namibian Grade 10 Geography syllabus and how these are represented and implemented through teacher intentionality and practice. The discussion is validated by pointing to evidence which was presented in Chapter 4 and orientated to key ideas and concepts that inform the study as presented in Chapter 2.

5.2 Discussion of the Findings

5.2.1 The presentation and representation of environmental problems.

The syllabus and teachers' intentionality and practice play a major role in shaping learners' understanding of environmental problems. Because teachers' understanding of environmental problems and approaches were guided by the syllabus during the lesson presentations, a similarity between the syllabus and teachers' intentionality and practice was evident in this study.

The study revealed that the teachers emphasised an understanding of environmental problems as socio-ecological (see Section 4.3.1.1). Teachers demonstrated an understanding of environmental problems not only as issues of the bio-physical, but as social, economic and political. Evidence in Chapter 4 illustrates that the syllabus similarly discusses environmental problems in relation to socio-ecological, economic and political issues (see Section 4.3.1.1). In regard to this Hattingh (2004 – Section 2.8.1) argues that the social, political and economic spheres rest within the ecological sphere and if there are problems in the ecological sphere, the social, political and economic spheres will be affected (see also Lotz-Sisitka, 2004; Lotz-Sisitka, et al., 2006; Fien, 1993; Hattingh, 2004; Janse van Rensburg, 1996; Reddy; 2011-Section 2.8.1).

The study reveals that teachers use this understanding to address the complexity of environmental problems. This is because during the learning processes the teachers not only

explained one area of concern, but addressed the complexity of environmental problems as problems between ecological, social, political and economic spheres. For example, Teacher 1 used the example of unemployment, food security, burning of trees for commercial use and logging of trees for furniture to explain the tensions between socio-ecological and economic dimensions of environmental issues (see Section 4.3.1.1). Teacher 1 also used an example of mining as one of the sectors of the Namibian economy which contributes to environmental problems (see Section 4.3.1.1). In another example, Teacher 2 used the example of poverty and high cost of living to explain the inter-relationship between society, economy and environment (see Section 4.3.1.1). In addition Teacher 1 presented many cases which highlighted the tensions between socio-ecological and economic dimensions of environmental issues during her lessons presentation, but did not elaborate, while Teacher 3 did not specifically highlight these complexities.

Beck (1992) argues that environmental problems need to be assessed using both social and scientific rationality. An interest in social rationality was evident in the syllabus which explicitly encourages society's voice and experiences in assessing and understanding environmental problems through case studies on local issues which expose learners to examples of real life problems (see Section 4.3.1.2). As reported in Chapter 4 Teacher 1 talked about social rationality in the focus group interview when she talked about how she sometimes gave learners a topic that she would be teaching the following day by sending them to do a mini-research project to find out about the local community's experience of particular environmental problems and how to respond to these (see Section 4.3.1.2). As evident in Section 4.3.1.2 this was not integrated in to the issues explored in the two lessons observed.

The syllabus also encourages Geography teachers to provide scientific knowledge about human processes to assess and understand environmental problems (see Section 4.3.1.2). The focus group discussion revealed that Teacher 1 and Teacher 2 are sometimes faced with challenges when discussing environmental problems which require scientific explanation (see Section 4.3.1.2). As evident from Chapter 4, Teacher 1 used scientific rationality when she explained how chemicals from mining and agriculture cause land pollution (see Section 4.3.1.2). Teacher 2 used scientific rationality in both of his lessons when he talked about how overcrowding

contributes to carbon dioxide (but he did not explain further how this happens) and how water pollution as caused by overpopulation (see Section 4.3.1.2). Teacher 3 centred his lessons for pollution and climate change using scientific rationality only (see Section 4.3.1.2). The study also revealed that Teacher 3 used scientific rationality when he explained the destruction of ozone layer by chlorofluorocarbon and other gases. However this was inaccurate, because only chlorofluorocarbons destroy the ozone layer (see Section 4.3.1.2). Therefore, all the cases presented in the study using scientific rationality were not fully elaborated and at some points incorrect information was given.

In Chapter 2 it was argued that environmental problems are no longer tied to their place of origin, but ignore national and international borders and affect everyone (Beck, 1992; Le Grange, 2003; Mythen, 2004; Reddy, 2011 - see Section 2.8.3). The Geography syllabus requires teachers to provide learners with skills and competencies which will help learners to understand that local environmental issues have global effects (see Section 4.3.1.3).

As reported in Chapter 4 there was nothing explicitly highlighted in the lessons observed as cross-border problems (see Section 4.3.1.3). Teacher 1 discussed cross-border problem implicitly when she talked about extinction of species and loss of nature “from pollution” from one place affecting another place (see Section 4.3.1.3). The study also revealed that Teacher 3 discussed cross-border issues implicitly when he discussed about ozone depletion and acid rain as cross-border effects of pollution (see Section 4.3.1.3).

5.2.2 The presentation and representation of problem solving methods.

As shown in this study, a limited variety of teaching methods were used by the teachers to teach problem solving strategies. This was in contrast with the syllabus which suggests teachers should use a wider range of teaching methods when teaching environmental problems in Geography to increase learners’ understanding during the lesson. The data revealed that prior knowledge/lived experience and guided questioning were the two common teaching methods used in teaching environmental problems during lesson presentations (see Section 4.3.2.1 and Section 4.3.2.4).

Section 4.3.2.1 reports that the syllabus encourages teachers to use learners' prior knowledge in teaching environmental education in order to relate environmental problems to learners' experiences. As reported in Chapter 4, teachers used learners' prior knowledge and lived experience in the theme of pollution and deforestation topics to explain and clarify learning content to the learners (see Section 4.3.2.1).

Learners participated actively when this teaching method was used by Teacher 1 in her first lesson presentation and Teacher 3 in both his lesson presentations (see section 4.3.2.1). According to Rosenberg, et al., (2008) the use of prior knowledge and lived experience in teaching environmental education helps teachers relate new knowledge to learners' own experiences about environmental problems. For example Teacher 1 used example of littering at the school ground to relate to learners' lived experiences when she explained land pollution (see Section 4.3.2.1). In another example, Teacher 3 used example of teachers at his school, many who use their own cars to relate emission of carbon dioxide in the atmosphere to learners's lived experiences

The study revealed that none of the three teachers used the fieldwork teaching method in their lessons even though teachers were aware of the importance of fieldwork (see section 4.3.2.2). Fieldwork according to Rosenberg, et al., (2008) engages learners in a real life situation and according to Cotton & Winter (2010), promotes learners' understanding (see Section 4.3.2.2). This is in line with what UNESCO (2011) argues, that fieldwork links theory to real-world instances which help learners to understand environmental issues and practices.

The teaching observed in this study did not involve learners in practical activities either inside the classroom or outside. Rosenberg, et al., (2008-Section 2.4) argue that practical activities can develop learners' inquiry skills, conceptual understanding and broaden their insight. The study also revealed that teachers understand that the Grade 10 Geography syllabus does suggest that teachers use fieldwork teaching methods, when teaching environmental problems to increase learners' understanding as expressed in focus group discussion (see Section 4.3.2.2). Teacher 1 pointed that she normally do field work with learners after hour.

The competencies that can be achieved through the fieldwork method are evident in the syllabus which aims to develop learners' skills such as: observation, investigating, collecting, analysing, interpreting data and presentation skills (see Section 4.3.2.2).

As discussed in Chapter 4 the syllabus also encourages teachers to use teaching methods which allow learners opportunities to find new information (see Section 4.3.2.3). None of the three teachers used literature research in the lessons observed. However, Teacher 1 said that she sometimes uses a literature research method, by asking learners to go through textbooks to read and find out some solutions to the environmental problems being studied (see Section 4.3.2.3-FT1).

The study revealed that guided questioning was the most common teaching method used by all three teachers. In all lesson presentations the teachers involved learners through asking them questions to define concepts, to explain some things, to think through complex unsustainable practices or to guide them to find solutions (see Section 4.3.2.4). It was evident that the teachers were aware of what the syllabus says about directing learning through probing and guiding questions. This was evident during the focus group discussion (see Section 4.3.2.4). Rosenberg, et al., (2008- Section 2.4), argue that guiding questions increase learners' involvement in learning process and as a result it develops their confidence in increase. This was evident in all lesson presentations, whereby teachers directed and probed learners' thinking to support them to think more about causes and effects of particular issues and their solutions (see Section 4.3.2.4–Teacher 1, 2 and 3 examples). For example Teacher 1 guided learners with questions by challenging their simplistic responses/solutions highlighting for example that burying and burning will not solve the problem of land pollution (waste management). In another example Teacher 2 used guided questions when he probed learners to challenge them on the suggestion that avoiding washing in the river could be the best solution for water pollution. This illustrates the potential when using guided questioning to attain more depth of understanding through probing, but also implies that the teacher needs to know the topic well enough to be able to respond spontaneously to learners' ideas.

The study revealed that none of the three teachers used a demonstration teaching method in their lessons even though some teachers were aware of the importance of demonstration (see Section 4.3.2.5). Focus group discussion revealed that Teacher 2 pointed out that he had used simple demonstration in the past when he burned papers to illustrate air pollution (see Section 4.3.2.5). Rosenberg, et al., (2008-Section 2.4) argue that demonstration is one of educational tools which is used to scaffold the development of complex concepts. This is in line with the syllabus which aims to promote skills such as: measurement, location, identify, build, act out, draw, dramatise and demonstrate (see Section 4.3.2.5).

5.2.3 Problem solving in relation to constructivist learning principles

This reflection on problem-solving is discussed in relation to social constructivist theories, because the Namibian Curriculum encourages the adoption of social constructivist approaches to learning in classroom (Amutenya, 2009). In Section 2.9 four key principles of social constructivism were identified drawing on Slavin (2012) in relation to problem solving teaching methods. These were: 1) the socio-cultural context, 2) the importance of language in learning, 3) the zone of proximal development [ZPD] and 4) the role of the teacher during scaffolding. These are discussed below to help describe how teachers facilitated collaboration between learners in solving environmental problems.

The evidence from these lessons showed that all three teachers centred their lessons on the learners' socio-cultural context and their lived experiences (see Section 4.3.2.1). This was evident in all lesson presentations, when teachers posed questions which required learners to share their socio-cultural context when giving responses. These findings resonate with Berk & Winsler's (1995) argument that through joint activities in socio-cultural context learning will promote problem solving skills (see Section 2.9.1).

In Chapter 2 a second principle of social constructivism namely language, was highlighted as a tool for dialogue and sharing understanding during problem solving (see Section 2.9.2). As evident in Section 4.2.1.2, 4.2.1.4, 4.2.2.2, and 4.2.3.2 language was one of the commanding tools (Berk & Winsler, 1995; McInerney and McInerney, 2006-see Section 2.9.2) used by teachers to encourage learners to ask questions, to argue and to speak their minds in all issues

during teaching and learning processes. Evidence in Chapter 4 shows that learners' logical thought was expressed through language when they were suggesting possible solutions to environmental problems during learning processes. For example Teacher 2 encouraged his learners to ask questions regarding the task given to them and learners did ask (see Section 4.2.2.2). In another case a learner for Teacher 1's class challenged her that the school ground is not polluted because the learner did not see papers as waste materials (see Section 4.2.1.2). Also in Teacher 1's first lesson her learners suggested one solution to land pollution which was to put non-recycle materials in one place (see Section 4.3.2.4).

This reflects the suggestion put forward by Hodson & Hodson (1998) and McInerney & McInerney (2006) that teachers should recognize the connection that exists between language and learning in order to encourage problem solving activities in their teaching (see Section 4.3.2.4). Through language the teachers interact with learners to facilitate collaboration in solving environmental concerns (see Section 4.3.2.4).

Furthermore, a third principle of social constructivism namely zone of proximal development is evident in the data generated in this study. Section 2.9.3 explains that a ZPD refers to a space where a teacher and learners work together on tasks which learners could not perform independently because of difficulty level (Scott, 2008; Daniels, 2004). The findings presented in Chapter 4 give an idea of how teachers worked with in the ZPD to guide and collaborate with learners through problem solving activities (see Section 4.2.1.4 and 4.2.2.2). This was evident in Section 4.2.1.4 when Teacher 1 helped learners by explaining some actions in to be taken to reduce deforestation. Evident to this also in Section 4.2.2.2 where Teacher 2 helped learners by explaining the word rapid which they could not understand.

These findings reflect the suggestion puts forward by Schunk (1996) who argues that one role of a teacher is to give learners activities that are within their ZPDs that challenge them, but that can be accomplished with responsive adult help. According to Daniels (2004 – Section 2.9.3) this resonates with teachers' responsibilities to make sure that learners' learning is maximised by actively collaborating in given tasks.

As argued in Chapter 2 scaffolding has a significant influence on the way in which teachers and learners engage in collaborative problem solving activities (Berk & Winsler, 1995 - Section 2.9.4). The findings presented in section 4.3.2.4 show that the teachers scaffolded learners in their lessons through asking them probing and leading questions (section 4.3.2.4). This is also supportive of the argument put forward by others such as Tuckman & Monetti (2011) who advocate that scaffolding provides learners with opportunities to work with teachers through activities by promoting their thinking through asking them leading questions, correcting and asking learners to explain. The teachers involved in this study showed that they had the competencies to scaffold learners when teaching problem solving skills (see Section 4.3.2.4 – Teacher 1, 2 & 3 example of guided questioning).

5.2.4 The presentation and representation of problem-solving models for problem solving.

As discussed in Chapter 2 an emphasis on action to address environmental problems through learning activities is a key process that facilitates problem solving skills and enhances learners' willingness to respond to environmental problems (Jensen & Schnack, 1997 - Section 2.4). The findings presented in Chapter 4 give an idea of how teachers set up problem-solving processes to engage learners in problem solving with respect to environmental concerns (see Section 4.3.3).

The syllabus states that teachers should use the local environment to plan and carry out simple projects which promote the development of geographical skills such as; identify a local problem, collect data, analyse and present collected data. It further says these simple project reports could be used to facilitate the understanding and action taking/problem-solving of environment risks and issues. The use of a problem-solving processes model can develop learners' problem solving skills in order to develop responses to environmental problems (Murray, 2005 - Figure 2.1).

Evidence presented in Chapter 4 suggests the use of a limited number of problem-solving steps used in the process of problem solving in the cases in this study (see Section 4.3.3). The study reveals that in all of the environmental problems cases presented by the three teachers observed, Step 2 (planning and researching/investigating) and Step 5 (Taking action) were not used in presenting environmental problems (Appendix 6). A further feature of the problem solving strategies used was that there was significant evidence that in all six lesson presentations teachers

used a linear process of cause, effect and solutions to address environmental problems. This is highlighted in the following examples:

- In Section 4.2.1.2 in the theme of pollution Teacher 1 asked learners to mention the causes of land pollution, its effects and possible solutions.
- In Section 4.2.1.4 in the theme of deforestation Teacher 1 asked learners to mention the causes of deforestation, its effects and possible solution.
- In Section 4.2.2.2 in the theme of population Teacher 2 asked learners to mention the causes of overpopulation, its effects and possible solution.
- In Section 4.2.2.2 in the theme of pollution Teacher 2 asked learners to mention the causes of water pollution, its effects and possible solution.
- In Section 4.2.2.2 in the theme of deforestation Teacher 2 asked learners to mention the causes of deforestation, its effects and possible solution.
- In Section 4.2.3.2 in the theme of pollution Teacher 3 asked learners to mention the causes of air pollution, its effects and possible solution.

This linearity can be linked to the absence of Step 6 (Did it work? Change or identify new problem and repeat the process) in the problem-solving process in which solutions might have been critiqued, revisited and thus dealt with in more depth. Furthermore, it is likely that the dominance of the question and answer method in the reviewed lessons might be another contributing factor to these simplistic and linear explorations of problem-solving in these classroom contexts.

5.3 Conclusion

In this chapter the study discussed environmental problems solving lessons to gain a close look into the research question and goals. A set of findings were used to lead the discussion of how teachers present environmental problems to learners. This study demonstrated that the complexity of environmental issues is highlighted at varying degrees of depth in the syllabus and in teachers' intentionality and practice. The study revealed that the understanding of environmental complexities through socio-ecological and economic dimensions were highlighted by teachers, but were not elaborated in depth. The study also found that the understanding of

environmental complexities which were highlighted through social and scientific rationality were not elaborated and at some point incorrect information was given in scientifically rationalised arguments. Furthermore, understanding of these complexities was limited by the degree employed by the teachers to address these environmental issues. The study also found that the understanding of environmental complexities through a cross-border issues was not highlighted explicitly or completely was not highlighted at all. The study also revealed that limited teaching methods were used in problem solving strategies. These included prior knowledge/lived experience and guided questioning, but these teaching methods had some limitations. It was highlighted in the study that the limitations of these teaching methods were that simplistic solutions were suggested. The study also revealed that problem solving was influenced by different social constructivism learning principles (socio-cultural context, language, the zone of proximal development (ZPD) and scaffolding). The study found that teachers structured their lessons around learners' socio-cultural context. The study also revealed language was a tool used by learners for logical thinking when they were suggesting for possible solutions for environmental issues. The study further revealed that the teachers worked within the ZPD to guide learners through problem solving activities. The study also revealed that learners's thinking was promoted through asking them leading questions, correcting and asking them to explain. The study further shows that a limited number of problem-solving model steps were used in the process of problem solving, and that a linear emphasis on problem-solving may limit more in-depth critical thinking in problem-solving processes.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents a summary of the study and its main findings in relation to the research question. Based on the findings, that are presented in Chapter 4 and discussed in Chapter 5, this chapter presents lessons learned about the presentation and representation of environmental problems in Grade 10 Geography syllabus and classrooms in the context of risk society and the presentation, representation and implementation of problem solving methods in the same context.

6.2. Summary of the study

The following section provides an overview of the research process and research findings as a means of reflection and highlights primary dimensions of the study.

This interpretive case study was conducted in three schools in the Rundu circuit, in the Kavango region. The study employed qualitative methods, specifically document analysis, focus group discussion and classroom observations. Ethical issues were taken into consideration by informing participants of the aim of the study and giving them the opportunity to choose whether to participate in the study or not.

This study was designed to answer the following question: How are environmental problems and problem-solving methods presented in the Namibian Grade 10 Geography syllabus and how are these represented and implemented through teacher intentionality and practice? In order to answer this research question, three goals were formulated, namely:

- **Goal 1** To describe the presentation and representation of environmental problems in the Geography Grade 10 syllabus, teacher intentionality and teacher practice.
- **Goal 2** To describe the presentation and representation of problem solving teaching methods in the Geography Grade 10 syllabus, teacher intentionality and teacher practice.

- **Goal 3** To describe the presentation and representation of problem solving processes in the Geography Grade 10 syllabus, teacher intentionality and teachers in practice.

The findings of the study were validated by pointing to evidence which was presented in Chapter 4 and orientated to key ideas and concepts that informed the study as presented in Chapter 2. These were captured in the form of findings summarised below.

The presentation and representation of environmental problems.

With respect to Goal 1, the study found that the complexity of environmental issues is highlighted in the syllabus and in teachers' intentionality and practice. However, in the case of teacher practice the potential for developing understanding is not fully realised. The teachers' understanding of environmental problems and approaches were guided and influenced by the syllabus during the lesson presentations. The teachers emphasised their understanding of the complexity of environmental problems that exists by virtue of their ecological, political, social and economic dimensions. The study revealed that teachers use this understanding to address the complexity of environmental problems. This is because during the learning processes the teachers not only explained one area of concern, but addressed the complexity of environmental problems as problems between ecological, social, political and economic spheres.

The study found that the syllabus explicitly does encourage society's voice and experiences in assessing and understanding environmental problems through case studies on local issues which expose learners to examples of real life problems. The study found that this did not happen during the teaching practices.

The study also found that the syllabus encourages Geography teachers to assess environmental problems using scientific knowledge. Teachers cited the challenges they faced when discussing environmental problems which require scientific explanation. The study found that all the cases where scientific rationality was used was not always fully elaborated and at some points incorrect information was given.

The study found that the syllabus encourage teachers to help learners to understand that local environmental issues have global effect. The study found that environmental cases which were

discussed by some two teachers as cross-border issues during lessons, were not highlighted explicitly as cross-border issues by these teachers.

The presentation and representation of problem solving methods.

With respect to Goal 2 of the study the research showed that limited teaching methods were used in problem solving strategies. The limited use of teaching methods contrasted with the syllabus which suggests that teachers use a wider range of teaching methods when teaching environmental problems in Geography to increase learners' understanding during the lesson. The study found that one of the limitations of these teaching methods was that simplistic solutions were suggested.

Problem solving in relation to social constructivist learning principles

Further insight into Goal 3 of the study was given by reviewed problem solving in relation to constructivist learning principles. Four key principles of social constructivism were in Section 2.8 (Slavin, 2012) in relation to problem solving teaching methods. These were: 1) socio-cultural context, 2) the importance of language in learning, 3) the zone of proximal development [ZPD] and 4) role of the teacher during scaffolding.

The study found that teachers centred their lessons on the learners' socio-cultural context and the lived experiences which required learners to share their social-cultural context during lessons. The study also found that learners' logical thought was expressed through language when they were suggesting possible solutions to environmental problems during learning processes. Through language the teachers interact with learners to facilitate collaboration in solving environmental concerns. The study found that the teachers worked within the ZPD to guide and collaborate with learners through problem solving activities. The study also found that teachers promoted learners' thinking by scaffolding learners through asking them leading questions, correcting and asking learners to explain.

The presentation and representation of Problem-solving models for problem solving.

Insight into Goal 3 of the was achieved through reviewing the way that problem solving process was modelled in the cases. A limited number of problem-solving model steps were used in the process of problem solving. The study found that the Grade 10 Geography syllabus does encourage project reports (Section 5.2.4) which could be used to facilitate the understanding and action taking/problem-solving of environment risks and issues. The study also found that all the teachers involved in the study presented problem-solving as a linear process of cause, effect and solution to address environmental problems.

6.3 Limitations of the study

One of the limitations of this study was that there were only two participants in the focus groups discussion, because one of the participants left the discussion before the discussion started. More participants in the focus group discussion would quite likely have provided more interesting additional data and insights into the research question. Another important aspect that would have deepened the findings would have been a document analysis of the Grade 10 Geography textbooks used by teachers and also learners' work. Conducting an interview with a Geography advisory teacher could be another aspect which would be considered in order to generate additional descriptive data on how environmental problems are presented and represented and how problem solving teaching methods are implemented and represented in environmental education activities in the Grade 10 Geography syllabus in Namibia.

6.4 Further research

From the data gathered and the interpretations generated in this study, I recommend the following as aspects for further research:

Other small scale studies similar to this study should be undertaken as to how environmental problems are presented and how problem solving teaching strategies are integrated in

environmental education activities in other grades. This should provide a rich source of data to broaden the findings reported in this study.

6.5 Recommendations

As evident from the study the understanding of the complexity of environmental issues could be strengthened in teacher education and classroom context by building on good understanding of the socio-ecological nature of environmental issues.

The findings in Chapter 4 indicate that Geography teachers involved in this study have a challenge with presenting environmental problems using both social and scientific rationality and that they are therefore not fully oriented to the social and scientific concepts in environmental learning. It could be interesting to develop an intervention programme to strengthening the capacity for using both social and scientific rationality and making the cross-border effects of environmental issues more explicit.

As indicated in Chapter 4 and in the discussions above, teachers used a limited variety of teaching methods for teaching environmental problems and promoting problem solving skills. Further intervention could be made to empower teachers with knowledge and skills regarding a wider range of teaching strategies in order to broaden the scope of choice in problem-solving contexts.

As evident in the study, teachers used a limited number of problem-solving model steps in the process of problem solving. In addition the teachers used a linear process of cause, effect and solution to address environmental problems. Interventionist studies could be done to support Geography teachers to use more complex and cyclical problem solving strategies to deepen problem solving and to engage problems in more depth.

6.6 Conclusion

This study has concluded that teachers do understand and present environmental problems as socio-ecological issues, but the understanding of the complexity of environmental issues was

limited by the degree to which both social and scientific rationality were employed. Moreover the study found that the cross-border issues were not explicitly presented in the lesson observed.

This study has also found that teachers' knowledge regarding environmental problems needs to be addressed to strengthen knowledge of scientific concepts in environmental learning. This study has also concluded that teachers used a limited variety of teaching methods to engage learners in environmental problem solving activities. The study found that the teaching methods used during the study had some limitations. The limitations of these teaching methods were that simplistic solutions were suggested. The study also confirmed that the teachers had not been introduced to how to use models for supporting the development of problem-solving skills. It was concluded that Geography teachers do scaffold learners in environmental education using problem solving methods, but engaging more possible steps and adapting to a more cyclical approach to problem-solving could strengthen and deepen problem-solving in the classroom contexts.

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APPENDICES

Appendix 1 Focus group discussion schedule

Environmental problems

What is your understanding by the term environmental problems?

What topics the Geography syllabus relate to environmental problems?

Describe, how you teach environmental problems to the class

What challenges do you face regarding the teaching of environmental problems?

Do you think teachers are doing enough to help learners to understand environmental problems?

What is your experience of teaching environmental problems in Grade 10 in Geography?

In your opinion how does the syllabus promote the teaching of environmental problems?

Problem solving

How do you understand the term problem solving?

How does the ecology topic promote the teaching of problem solving?

How does grade 10 Geography syllabus promotes problem solving?

How do you introduce problem solving to the learners?

How do you teach problem solving in a Grade 10 Geography class?

What LSMs do you use in teaching problem solving?

Describe your experiences in using problem solving.

What are the challenges you face in teaching problem solving?

Teacher-learner interaction

How does the teacher prepare learners for a problem solving activity?

How do you engage learners in problem solving activities?

How do you support learners when using problem solving?

Where do learners appear to have difficulties when using problem solving?

How does the teacher help them through the difficulties?

What difficulties does the teacher encounter through this process?

How does s/he address these difficulties?

Appendix 2: Focus group discussion Transcript

Socio-ecological relationship

Social/scientific rationality

Local/global issues that affect individuals/global village

How do you understand the term environmental problems

F-T1: I think these are the relationship we link with the environment and the resources that we use. Us humans we benefit from the environment whereby we use it for our own good or our own benefits right, but when we use our environment sometimes we over use it at the end we are destroying the environment from how was created as a nature and then we turn it the other way around we change it not how it suppose to be. It will be a problem to the environment. Aa if the is a problem in the environment that problem in the environment can also cause to human. I think that is

F-T2: Yaa!! just the same understand environmental problems the way I understand is the problems that is created by human beings as we are trying to harvest the environment to benefit ourselves, us my colleague said then we end up over using or trying to pollute the environment example like water pollution, air pollution that how I understand this are the environmental problems.

What topic in the Grade 10 Geography syllabus that is relate to the teaching of environmental problems?

F-T2: The topic that is related to the environmental problems I think is ecology; ecology is the one that talks of environmental problems and also trying to address how to revert the situation. Apart from ecology, geomorphology also talks about environmental problems, the part of weathering. Weathering especial when you talk about erosion its human being who are contributing to erosion it might be part of it.

F-T1: Then I think apart from weathering, erosion and ecology, population Geography also contribute to environmental problems. If you look now at over-population, means that people there will use much of the land in order for them to settle or to cultivate so it will cause problems to the environmental.

Challenges we face when teaching environmental problems

F-T1: Where we normal have arguments, when we look at air pollution that also contributes to global warming. When we discuss global and the ozone layer that is where I find more

challenging on how can I now real make learners understand how the atmosphere has high temperature or how it contain more temperature, whereby the high temperature cause now what we cause global warming and its effect. With them, they understand that if the UV rays is very high, it make the ice at the polar region to melt so that it can cause flood, that where now we arguing that UV rays is something different form the global warming or something else. It is challenging some of the things that we can now show for them to see exactly or is very hard to explain.

F-T2: It's true because some of the things are scientific, so we cannot prove it. When we talk about global warming and ozone layer you just talk it in general but you cannot show it the learners in reality. Let's say maybe sometime if we look again where we live, some of our learners they live near the river, you tell them don't wash in the river, don't swim in the river, so you just discuss it, but looking at the person where he live or may be poverty contributing factors. There is no option so you have to do it, but you know what you are doing is wrong. I think those ones are challenges to put in real situation where maybe we are failing.

F-T1: Because they do it to survive and where can they wash their clothes if they don't have traps.

F-T2: That is true, that is the problem. For example, when we talk about deforestation, trees are important to us. These kids or their parents are depending on trees in order to make away to survive, so those once no other option you talk about electricity, people don't have electricity at home, because the solution there is that, people there were suppose to use electricity, gas those things that you are mentioning people don't have it, so where we live it's also affecting us to implement so of these measure.

What factors are preventing teachers not to let learners grasp the concept?

F-T2: I think what is preventing us not to succeed maybe the environment where we live. These kids their parents are not educated they don't know anything, if you look at the government, there is nothing that is running, about this environment problems. I don't see that one not even something like a policy or campaign in place. I think there is lot to say even at school itself, now looking at the management people who are running the school now some of them maybe the subject that we do its different. Some of the subjects you know they don't talk of environmental problems perhaps is also one of the factor which is preventing us not to succeed, because if they could have understand it. I hope they could try to come up with some measures in order to improve the understanding I think that is also another problem.

F-T1: Okay! Maybe to add on just are ways in our culture or tradition because they are still those who are practicing, to make fence with trees or building with trees in order for them to make their hedge, because they cannot afford. On the other hand some they can afford but they want that traditional house just to what word should I use now to preserve their culture.

What topics did the revised syllabus brought in regarding environment problems?

F-T2: Normal there was no, not much changes that were made, I think what they did normal to take some of these topic out and then bring some new topics, but not a lot of topics, but looking at the environment itself, there was nothing just the same as the revised curriculum, they did not pay attention on bringing some of the things. The only topic which was brought I hmm what is this one hmmm bush encroachment. Bush encroachment was not in the past, ya!! I think that is the only topic I see which was not discussed in the previous syllabus. Then apart from that no, it is just the same normally. They just took some of the topics out, maybe trying to balance things with time now that is what they did, but the changes were not very much hmm!

F-T1: For the new teachers what should I have to compare there, the same things that I am teaching each and every year, I would say that some of the solutions which are there, or let me say that maybe they omitted some of the solutions that people suppose to know in order for them to solve their problems and they omitted some of the cause. If you look at what people do, some of the things are not in the textbook only that I cannot remember exactly.

F-T2: Because you see the problem, another problem, this book where normal, let me say it was write on another environment, what can I say maybe different country not basically in Namibia, but we are just trying to link it, but you can see that this book was designed or the syllabus normally, the way they design it like some of the things like we don't know the people who are doing it not from Namibia, not our own people who know our environment, maybe from somewhere or they were hired, so then now I don't know, but, that is what I see some of the things are not linked to the Namibian context!

In our opinion how does the syllabus promote the teaching of environmental problems?

F-T1: I will say that the syllabus maybe it got more information maybe the basic competencies if you compare now to the reality because they are looking at the problem, how we cause it and the effect and some of the solution, how we can

solve that problem. So I will say that maybe the syllabus is touching each and every corner of environmental problems.

F-T2: It's just the same, because the syllabus itself you know even if you look on those topics it's not straight forward topic, maybe some information is getting there. As my colleague said it only touches about the problems, how we cause it and how it affects us, but they did not even suggest some other activities. So I think the syllabus content itself is limited.

How do we understand the term problem solving in general?

F-T1: Problem solving is not totally to stop that problem, but you are trying now to look at the solution, what can you do maybe to reduce the problem so that it cannot be caused in that high percentage, just to reduce some of the problems, but you won't be able to solve it totally that it won't happen again. So you are just trying certain ways how can you reduce it, so that it cannot happen in the future.

F-T2: You see it's just the same problem solving normally is when you are talking about the problems that we have created ourselves. Perhaps we must try to find away on how to reduce that problems. It's how I understand that term problem solving. We created our own problem maybe we must try to find on how to solve those problems in short.

How does ecology topic promotes the use/teaching of problem solving?

F-T1: How does it promote the use of problem solving? If we look at the textbook which is prescribed by the syllabus some of the solutions are limited some are not there as I said it earlier. So now, if you look at reality itself even learners can tell you some other solutions to that specific problem which are not in the textbook. So it makes learners how to think of critical on what they suppose to do in order to solve that problem, even it is not in the textbook.

F-T2: Normally the textbooks or the syllabus somehow they are trying like the suggestions they are giving. For example; now if you cut a tree, at least you must plant some trees. Yaa!! That is all, but people do come up with some new ideas as I know it need to be a proved by certain people before they start using it. So, the way we are teaching it normally, it is limited we just follow what is there, because if you come up with ideas, that ideas needs to be approved, before you use it.

So how does the syllabus promotes the teaching of problem solving?

F-T2: Aah, as we said normally, the syllabus is not so wide because maybe the time, if you look at time also, you know like field work it needs time, but grade10 aaah! I don't think there are field works. I think 15-20 time land transcend that one; you can take learners outside to compare plants that are growing on certain areas. Apart from that, I think those people they consider time also maybe and the level of the learners' maybe and the level of the learners' maybe them to do field work to take learners outside, but the teacher can still arrange and then you can make these learners to be at an environment to make some research. The syllabus itself normally hmm not so much happening

As we talked about how we introduce environmental problems. Then how do we introduce problem solving?

F-T2: Normally in case what I do first I don't give them the answers. Let's say this is the topic and this is the problem, let us find the way now how can we solve this problem? Learners first have to try the responses from learners you know it's real different, very differ. Then from the most of the answer normal some there will be on the right track, the majority you see there will tell you something. Then from there, as a teacher you now give them possible answers. That is how I introduce it. I give the work them first to try and give the correct answers.

F-T1: Ok with me instead of giving solution just generally, and then we just do it together to look to each. If we are saying maybe cutting down trees for firewood so that firewood what can we do to prevent cutting down trees for firewood? We are looking at problem to problem until all problems are given solution.

What teaching aids do we normal use when teaching environmental problems?

T2-F: Teaching aids they use I mean as problem solving, I normally here, depend to the topic what I do as we said for global warming, I don't use anything, normal, this global warming then you talk about for example like deforestation sometime these learners they live where these plants are been planted near side the river, there we normally feel that in early it was not trees, all trees were cut down but then trees were replanted on those areas. Ahay!! From there, I normally use a picture that is all. We don't have enough resources at the school people who have access to internet the computer, but some of us where we are teaching no, like in the bush. So it is very difficult to bring these teaching aids now to problem solving not so much.

F-T1: With me I use the pictures and the textbook, but there are certain things that you need to prepare for other things. Aaah!! Then from there like last year I used the

teaching videos that I got from TRC after teaching afternoon, then I play others video to see if they got that, basically, I used the pictures and the videos.

You are using real world and visual aids, how do you see learners' response to these?

F-T2: Yaa!! In my case you now, because they know where these trees are planted, that one is a solution to deforestation that one I don't have any problem they understand, because everybody knows, but coming to other things is a problem. Even though you are trying, but, see that things for them do not clear understand.

Will you describe one of the moment which learners enjoyed or faced difficulties with when you presented environmental topic in geography?

F-T2: Yaa!! I remember one time we talked about land pollution, then we started cleaning from the class, we picked up papers. We went outside and picked up all the paper and then the environment was clean that one, they enjoyed it, mostly outside I don't know.

T1-F: Me, I can't remember any moment

If we can go back, when you used the video, I don't know how did it go? You used it last year or when?

F-T1: I used it last year, this year I did not use anything, but I only used it for Geomorphology, but I did not use it for ecology also. Okay, when I used the video tape, I will say that it was like a surprise to them for the problem that human cause, as if the first time for them to see it or maybe if they don't know that is what they do can result in that way. When they saw the video tape now they see what problems do human cause on the environment.

F-T2: Video, they normal enjoy learners watching, they enjoy even though that their attention is not 100% but they enjoy it.

You have more positive things on video than the posters. Then does the video give them that itch or ahah moment not to copy but make them want to go outside and do things themselves?

F-T1: I think it gives them the ideas on how to solving their problems, they real take it that way, how the problems are been solved and if they see it reality they will concentrate on it, because it show them how they cause that human activities, but then if they see it on video like they will be showing them steps by steps until the last point that's easy for them now to teach how to solve that specific problem. I

think video there are also good as a teaching or teaching support materials, if the learners they are not just enjoying the pictures. If they real listening, because the video not only the picture but there will be someone to explain what been shown in that video. So sometime you know you pose also so that you can explain what the people had talking, because our English and their English is different, so we try how to use simple English.

What are the challenges we are facing when we are using problem solving strategy when teaching environmental problem?

F-T1: Aah! May be when you are looking at problem solving as if now we are trying to discriminate the poor people who cannot afford to use other alternatives ways that they suppose to use. Now if you are forcing them to do things that they cannot afford to do. So is not good at all and this there to be used by us, or every though we be able to use it wisely aah. The solutions also not good at certain part, unless may be the government who try to do certain solutions maybe building houses to the people, which our government cannot even afford, because we don't have enough money. So everything has touched some certain group of people whereby some, there will benefit and some will be bad to them.

F-T2: Yaa!ooh!! There are lots of challenges normally! Laugh some of these challenges are teaching aids is not easy to get as I said it, you might try to borrow something from other school, but maybe you don't have now the TV to show them that things, that one is also a challenge and then also some of the challenges you know that something is somewhere far, but now to take learners there, transport cost, then you just drop it you will not continue. There are challenges normal with these teaching aids sometime you see, you use it, but later on you think aah! Maybe these kids they did not understand it well yaa!!! Those are some of the challenges that we are normal facings.

Teacher-learners relationship

How do teachers prepare learners for the problem solving activities?

F-T1: Okay sometime are at the end of the lesson, because you know that you will be teaching tomorrow so you don't real give them, you can give them an activity to write, but sometime about the topic that you be teaching tomorrow, if you know such problem they have it in their environment so you can now send them into the community and find out exactly what lead them to cause that problem and how they can be able to solve it so that they can reduce such problem.

T2-F: Here you mean that problem solving activities, activities that we give to the learners.

Umm!! That promotes problem solving or prepares them?

F-T2: Normal here we are trying all the best by letting them know, what to do so everybody is aware and then they also try even though sometime they don't get it right may be they wanted these things to be done, but looking at where they live is not easy to get it. The activities normal we prepare, but in my case here is just that I can produce a picture and then they can look at the pictures will help them to get the answers and then they can suggest it is how I normal help them to bring information close.

In the middle of the lesson, how do we engage learners in problem solving activities?

F-T2: Like me in my case what I do normally, I ask them to present it their findings. They present to the class to other classmates, they can comment or discussing their, then from the teacher's side repeating them now to analyze, to add to their answers that is what I normal do.

F-T1: May be apart from presenting, you can ask them to go through to read and find out the solutions in the textbooks. Some of the solutions are just indicate but are not explaining. Now as the learners are naming that certain solution, they should be able to explain it how do they understand and how to solve such problem.

How do you support learners when using problem solving?

F-T1: I think they give their solution that we try now to direct how the solution suppose to be, just to see if they can have any ideas how to use such problem.

F-T2: Nm Yaa!!! The support that we normal give, you know sometimes learners they want to mention something maybe there term is not. As a teacher you go in and try to make the sentence more clearly to the learners. Is one of the supports that I give? But I wish this problem can be specific now because we are just generalizing them now, because it depends from the topic to topic.

If you got any example to give you can just give how you support learners?

F-T2: Yaa!! For example normal the one which is close to use is just like these land pollution, deforestation, water pollution yaa!! Air pollution these one are like what I did last time a solution now to air pollution, the learners suggested now we want to create air pollution first so that we see how we can solve it that is them. I

let them to burn the paper. When they burned that rubbish now a solution to this one is to bury it. To bury these rubbish not to burn it, because now then I said ok, it is fine, but you see now when you are burying again you are also creating a problem, but they said no, air pollution is even more dangerous. I mean burning these papers better we bury these things.

Where do learners face challenges when using problem solving?

F-T2: I think they face a big problem especially when you talk it theoretically, for them they like doing things practical there normally they pick up easily. But just talk they just listen like their mind is just limited, but once you do practical, there you see that everybody is trying too. What I am saying is that if is practical for them is easy also to suggest. When is theoretical and they never heard about it may be is the first time they just listen, look at you their mind is not open to suggestions, but if they know at least they have some ideas maybe its practical. There we can say they are learning.

T1-F: I will be say that may be listening only is not a good ideas, because they pretend to listen, but they are dreaming, by the time you ask them questions you say it is clear then they say yes and questions no. But when you ask them, they are quite; they won't be able to respond, meaning that they did not catch up anything that you explain.

Now this by itself is a problem. Then how do we help learners to get through in these problems?

F-T2: Yaa!! Normally, the way we are trying, but sometimes what we do we try to create something that we be meaning in the classroom and then, then they have to focus there so in that way it is helping them, because instead of just talking something that you know, you can have picture. We always try if there is a picture or something that we help these learners for them to understand, that is the one we do normally. We bring things close to them if is possible, the way we can. But if there are things that we cannot say anything or like now let me say global warming you mention it, it comes tough now.

F-T1: May be a part from bringing LSMs for them to be kept in to the lesson, maybe to keep them busy now by talking certain things, you explain certain thing, you ask them just for them not stay long listening, they should also talk in the class, that will keep them awake.

What difficulties the teachers are encountering when they are helping learners to reach to the solutions?

F-T1: Maybe I say through helping learners, we will be almost, we be behind the time, let me say the time is not always enough for us now to finish whatever we prepare within that lesson. Because you are trying for them to concentrate as we are keeping them in the lesson the time is also going. Yaa!! I will say that maybe is the time limited within the process of learning.

F-T2: A part from time it also the difficulties that we normally face here and the whole process sometimes you have your ideas, maybe to take learners somewhere to show them something, then the authority cannot allow it. They say no this one will cost money no and what other things is also one of the problems. The other things that we normal face here sometimes you want these learners to do certain or show them and then it becomes very difficult to do it or is not possible to do it, and then you just drop it.

How do you address these difficulties then?

F-T1: With the time, always you can try and make up some extra class afternoon, because afternoon you won't be disturbed by certain periods that the other one will come in the class. You can just make up your own time for how many minutes or an hour that long so that you can explain everything and discuss everything with learners so as you want it to discuss it. If you look at limited power let's say that if the amount is not that big, you can ask learners to contribute and then you add on then you go on what you want to do, or may be if the place is close by so you can maybe do it afternoon to walk and reach that place for you to do you activity there. I think that are some of the solutions.

F-T2: Yaa!! Maybe just to say in terms of time, there sometime we arrange afternoon so learners can come afternoon so we have enough time now to assist each and everyone.

If you have general things to say you are welcome to say it

T1-F: Me, I will be looking at saying the syllabus and textbook. Yaa!! I don't know who approve syllabus, because there is whatever textbook to be used or prescribed by the certain textbook prescribe by the syllabus, but still the government is sending different books whereby you get contradiction factors there. Let me give maybe explain for Grade 9 if you look at continental okay normal I used Geography in context, but this year I have received the Namibian Geography. So when I look at

it, there is confusion there, for Incontext its saying that oceanic crust heavy because it contain silicon and magnesium (sima), but for New Namibian Geography it say that oceanic crust is heavy because of silicon and aluminum (sial). It is the other way around in different books you don't know which one the right, which one is wrong. But they are saying Namibian context is the one prescribed by the syllabus, but the other one also is a Geography textbook. So I just really don't know. Maybe before they approve a certain textbook, someone should just go through with the syllabus to see exactly what is in the textbook

Appendix 3 Sample of classroom Observation 2

Socio-ecological relationship

Social/scientific rationality

Local/global issues that affect individuals/global village

Teacher: 1 (T1-Ob2)

Deforestation

T1: Ok as I said it earlier on we are looking at deforestation. Okay now deforestation is the cutting down of trees without replacing them that is what we call deforestation. You cut down then you don't replacing it. Okay let look trees in general, the trees we use it for different type of things

T1: Now what make a tree to be important? What is the importance of a tree in our life or to your life?

L1: It produces shadow

T1: It provides?

L1: Shadow

T1: Shadow/a shelter okay it produces shadow. A part from producing shelter

L2: It releases oxygen that we use for breathing

T1: Okay it releases oxygen that we use for breathing. What else?

L3: It provide fruits

T1: Okay it provide fruits

L4: It provide medicine

T1: Okay it provide medicine, some of us make medicine from the roots of the trees (like ntove)

L5: Use for building our home

L6: It provide firewood

T1: **Trees provide fruits, it provide medicine by using its leaves or roots in order to make some medicine, for building we cut down trees for building materials and provide firewood we cut down trees that we use it as firewood.** Now these are the importance of the trees in our life or that is how people depend on trees. Since we use it for these specific things, meaning sometime we cut down trees in order to get whatever we want to use it for. **When we cut down trees and we don't replace it that specific area where we depend on those trees it will be no more trees or no enough trees that is what we call deforestation or the process of deforestation is taking place.** **Now we can take the importance of trees and change it to the cause of deforestation.** What will be the cause of deforestation?

L7: **Use for building house**

L8: **Agriculture activity**

T1: Agriculture activity it can also cause deforestation. How can agriculture activity cause deforestation?

L9: **As the population growing everybody wants to be with his/her own land so they clear a large land for agriculture activity**

T1: **People are mostly, in developing countries depend on doing agriculture in order for them to feed their families, so most of the people they clear the land in order for them to cultivate their different types of crop there. The trees won't be there that will contribute to deforestation**

L10: Cut down for firewood

T1: **We cut down trees in order to use it as firewood and firewood** is source of?

Learners: Energy

T1: Is a source of energy, order for us to cook our food or keep ourselves warm, because we cannot be able to afford other sources of energy from that...

L10: Building homesteads

T1: Building homesteads, houses are they not of the same point apart from that one give another one again

L10: Fuel and charcoal

T1: So that we use it for fuel and charcoal, so they cut down trees and then they burn those trees. After burning those trees they take coal and then put some chemical that they sell in store. There are some certain boxes that we buy from store that they call charcoal. Those charcoal there are from where, they are from trees, what else?

L11: Making paper

T1: Making paper, paper is made out of?

Learners: Trees

T1: Out of trees, so the process goes on then they change to be paper. I don't know what type of machine they use so that the paper can be soft. We know that the trees are hard, but paper are out of trees what else that cause deforestation?

L12: Building kraals

T1: Building kraals, we say in agriculture, okay some of the people keep livestock such as cattle, goats, pigs and so on. These animals also have their own area to sleep or stay. So we cut down trees in order to make their kraals for those animals to be there, what else?

L13: Cut to make furniture

T1: Furniture such as chairs, desks, table for all furniture or most of the furniture there are all made out of the trees. That is why people cut down trees. What about wood carving?

Learners: It fall under furniture

T1: It falls under furniture, okay part from that?

Learners: Road construction

T1: Road construction, so whenever we want to construct road what do we do? If that area contains trees we are going to clear that area in order for the people to construct the road at that specific area. Those are cause of deforestation or those points that we listed are those that contribute to the process of deforestation

L13: How about the stadium?

T1: The stadium, where people do different types of sport activities? Okay let say that if that area contains trees before they started building the stadium, then they also cause deforestation, because that area is going to be clear, there won't be any trees there, so it can also contribute to that

Learners: Yes

T1: Okay now those are there things that contribute for the process of deforestation to take place. Since we looked at different causes of deforestation we see that everything is done by human. It is us who clear trees to construct roads, it is us who chop down trees for firewood, it is us who cut down trees for building materials or wood carving or whatever that we mentioned here. Now what can we do in order for us now to reduce deforestation or to find out a certain solution so that we cannot cause much problems on the environment? We are there one who cause it so we should also be able to look at what can we do to solve such thing?

T1: What about those people who cannot afford to use electricity, gas or solar panel? Okay in life we are not the same and we cannot afford whatever we want so we are looking at solution not that we are going to prevent deforestation totally, but we are looking for solution now if you

can afford such thing you are expected not to use firewood, but to use alternative source of energy. But if you cannot afford, there is nothing that we can do because you cannot afford. So you can still use now firewood and then again, even though you are using firewood make sure you replace it again as we said it earlier, because you cannot afford other source of energy. You cut it for firewood and then you replace for the future use okay, apart from that?

Learners: You use the wood and building materials to make hedge

T1: What is fencing? What is to fence something?

L20: You cut trees so that it can protect

T1: Is that now a fence, when you use trees and surround your yard?

T1: We also look at the government. The government should make the buyers and sellers of tropical wood illegal, meaning now those one who like cutting trees in order for them to sell now it should make that process illegal. In other way instead of making it illegal we know that some of the people depend on cutting down trees in order for them to get income. It should be able to put up a committee in order for them to limit the number of trees that you cut down and then you can be able to have licence or permission in order for you to cut down a certain number of trees, that will be able to reduce deforestation that we are have in our area. Okay now when we look at agriculture people they prefer to use slash and burning farming methods. Now people who do agriculture when we look at the process of slash and burn methods what does it mean?

Learners: Slash and burn method

L23: It means you cut all trees and see that you have clear

T1: Okay when you cut down trees or clear the land after that all those trees that you have cut down or the bushes you are going to burn them in order for the ash to be manure for your soil so that the soil can be fertilize so that is what we call slash and burn, that is what people should stop to do that kind of farming activity. Okay now and also people must look after wood we also look at the process of seed. If we look after the trees like the way we look after ourselves we can be able to reduce deforestation. We know that the relationship between humans and trees is very

important, because we depend on which others that is why we will be able to look after them. So the solution on deforestation what we can able to do reduce the process of deforestation not to happen at area, if we look at our area this area is very dirty

Learners: No unless other place

T1: Is that other village? Okay it does not matter whether our area or not our area, if we study this area very nice do you think deforestation occurred or not?

T1: There is just look at it we can see different kind of homesteads there even are they are far, but there is not enough trees. Most of the houses here were made of trees in order for them to build hedge. So that is the importance of trees in our life, okay now if look at the problems caused by deforestation we looked at what cause deforestation, the importance of trees and how we be able to solve it. Now if we are unable to solve this or unable to reduce deforestation, then deforestation can cause a problem to us or to the environment, what problem can deforestation cause if we are unable to practice the solution that we just listed here. What problem can it be able to bring?

L24: Loss of nature

T1: Loss of nature, how are we going to lose the nature?

L25: We are going to lose it if all trees are cut down including those trees that we can make medicine so there will be not be in the community unless you have to travel long distance, I mean far to get that tree

T1: To get those trees that provide medicine, okay now if we cut down most of the trees and we know that some of them they provide medicine. If it gets extinct at that specific area then we are going to lose that specific medicine in our area. Unless we go to the next village or we travel certain distance in order to get that tree and take to make medicine, a part from that?

L17: Yes, where can you take that old paper and be recycled it?

T1: Where can you take here in Rundu?

T1: To be honest with you both, tins cans and bottle you take at store, supermarket or brewer itself opposed Antlantic Oceano (this a name of a shop), but paper not to lie I don't know where can you take paper in Kavango region for recycle

L26: Teacher sometimes I use to find people I use to find people hammering old car

L26: Where do they take it?

T1: Where they send it? To those people who buy recycle things they take it to the recycling place in order for them to make up a products out of that , instead of just there to cause a certain pollution

L26 Is paper made out of wood?

Learner 7: Oil

T1-Ob2: Oil plastic, plastic is made out of oil

Learners: How?

T1: Can you be able to explain how?

Learner 7: **Plastics are made from oil when is refined, that is why when you burn plastic does not burn like paper it burn like those container for water, because these products that are made out from oil. That is why if oil split in the river fish will die. If plastics scattered around it take years before it can decompose**

T1: Now we know that paper is from wood and plastics are from oil. Let move on a part from the loss of medicine some of the people you don't want to talk to me

L27: **Lose of life and plants**

T1-Ob2: **Lose of wildlife and plants, now where do animals live, no plants, but animals I mean, where do wild animals live?**

Learners: Bushes or forest

T1: Yah we get them in the forest where are trees, grass and so on those are their homes. Now if we cut down large piece of area, those animals will not be able to stay on clear area and we know that they also feed on the environment which they live. If there area is clear those animals are going to move to another area where they will be able to get trees in order to feed on them and maybe to live there. So that is how you are going to lose wildlife. Earlier on we look at lose of medicine that is when we cut down trees, it also apply the same we are going to lose plants we have cut them down and not going to appear there that is the meaning of that, apart from that?

L28: Soil erosion

T1: Soil erosion explains it yourself?

L28: Because when there is no plant on the soil when it rains the wind will blow the top soil away

T1: Okay we know that the plant root they hold soil if there are no enough trees there when wind blow, when the water run maybe heavy rain, then the wind and that running water going to carry along the soil. Soil erosion can be also be able to happen there, a part from soil erosion?

L29: Increase carbon dioxide in the atmosphere

T1: How can cutting down of trees increase carbon dioxide in the atmosphere? You should be able to understand what we listing not are only making a new one that we don't understand, his friend help him to explain the point, she said that deforestation can increase high carbon in the atmosphere

L30: When you cut more trees, no trees will give oxygen to breath

L31: Trees absorb carbon dioxide okay in the area like this, they have cut all the trees, there is nothing that will absorb carbon dioxide and it will increase now

T1: When we have more carbon dioxide in the atmosphere it will cause what or it will lead to what?

L32: To global warming

T1-Ob2: That will lead to global warming, hold on to look at what I did not explain, soil erosion, loss of wildlife, carbon dioxide, decrease of soil fertility, you know that during winter or whatever period trees loss their leaves, these leaves can be able to decompose in the soil. So that it can be fertile, if there are no leaves there is nothing going to contribute to the soil fertility.

Appendix 4 Analytical Memo 1: Environmental problems as presented in the Geography syllabus and by teachers

Sub-Categories	Summary	Coding
Environmental problem presented as socio-ecologically related	The challenges and risks we face if we do not care for and damage our natural resources	GS, p. 4
	Geographers also study ways in which humans have adapted nature to meet their needs and requirement and to what extent humans are able to utilise their environment in a sustainable manner.	GS, p. 1
	The potentials and limitations of the physical environment for human activities	GS, p. 2
	The environment and the need for conservation	GS, p. 2
	Distinguish between natural causes and human-made causes [of deforestation]	GS, p. 38
	Know how they will impact on our society and on the quality of life our people now and in the future	GS, p. 4
	The challenges and risks caused by HIV/AIDS The challenges and risks to democracy and social stability caused by inequality and governance that ignores right and responsibilities	GS, p. 4
	Geography is within the social and economic area of learning in the curricular	GS, p. 1
	Participation in the social, civic, political, economic, cultural and natural environment is central to this area of learning	GS, p. 1

	It includes understanding and interpreting past events and present human behaviour and experience and how they influence events, circumstances and the environment	GS, p. 1
	Geography is a study of the earth and the interaction between humans and nature	GS, p. 1
	It examines humans in their interdependent relationship with the earth	GS, p. 1
	The relationship and interaction of people and their environment in response to physical and human processes, as well as aspects of the changing world	GS, p. 1
	HIV/AIDS and the impact on the socio-economic development	GS, p. 1
	How human activities can lead to environmental problems and improvement	GS, p. 2
	When we use our environment sometimes we over use it at the end we are destroying the environment from how was created as a nature and then we turn it the other way around we change it not how it would be	FT1
	Environmental problems the way I understand is the problems that is created by human beings as we are trying to harvest the environment to benefit ourselves	FT2
	Weathering somehow it also even though its nature itself, but it also causing some especial when you talk about erosion its human being who are	FT2

	contributing to erosion it might be part of it.	
	Population also contributes to environmental problems. If you look now at over-population, means that people there will use much of the land in order for them to settle or to cultivate so it will cause problems to the environmental	FT1
	If we look again where we live, some of our learners they live near the river, you tell them don't wash in the river, don't swim in the river, so you just discuss it, but looking at the person where he live or may be poverty contributing factors. There is no option so you have to do it, but you know what you are doing is wrong. I think those ones are challenges to put in real situation where maybe we are failing.	FT2
	Because they do it to survive, because where can they wash their clothes if they don't have taps.	FT1
	That is true is the problem. For example, when we talk about deforestation, trees are important to us. These kids or their parents are depending on trees in order to make away to survive, so those once no other option you talk about electricity, people don't have electricity at home, because the solution there is that, people would use electricity and gas. Those things that you are mentioning people don't have it, so where we live it's also affecting us to implement some of these measures.	FT2

	Our culture or tradition because they are still those who are practicing, to make fence with trees or building with trees in order for them to make their hedge, because they cannot afford. On the other hand some they can afford but they want that traditional house just to what word should I use now to preserve their culture.	FT1
	Okay now deforestation is the cutting down of trees without replacing them that is what we call deforestation. You cut down then you don't replacing it	T1-Ob2
	Use it for building house; okay we cut down trees in order to build our houses	T1-Ob2 & L5
	We cut down trees in order to use it as firewood and firewood	T1-Ob2 & L10
	Is that now a fence, when you use trees and surround your yard?	T1-Ob2 & Learners
	There is just look at it we can see different kind of homesteads there even are they are far, but there is not enough trees. Most of the houses here were made of trees in order for them to build hedge	T1-Ob2
	To get those trees that provide medicine, okay now if we cut down most of the trees and we know that some of them they provide medicine. If it gets extinct at that specific area then we are going to lose that specific medicine in our area, unless we go to the next village or we travel certain distance in	T1-Ob2

	order to get those tree and take it to make medicine	
	Lose of wildlife and plants, now where do animals live, no plants, but animals I mean, where do wild animals live? If there area is clear those animals are going to move to another area where they will be able to get trees in order to feed on them and maybe to live there. So that is how you are going to lose wildlife.	T1-Ob2 & L27
	When people are more than resources	P5
	This one is correct deforestation is correct natural resources will be finished easily; over cultivation those once are correct.	T2-Ob1 & P7
	Figure 6 show one cause of deforestation. Who want to remind us what deforestation is?	T2-Ob1
	The cutting down of trees without replacing them	P4
	Desertification, the answer supposes to be deforestation, but look here there are some trees, but looking here those trees are gone.	T2-Ob2
	What is deforestation? The cutting down of trees without replacing it.	T2-Ob2 & P3
	Looked at deforestation as one of environmental problem, we define it we looked at the causes and consequences, we looked at desertification, desertication, and we looked at the causes and consequences.	T3-Ob2

	Land pollution is when an area is dirty because of the waste that human are throwing on that specific area	T1-Ob1
	Now I gave you an example that side when you look outside, you can see that there are paper and plastics that you can find on the ground, that one automatically we are going to call it as land pollution. Now meaning our school ground is also dirty	T1-Ob1
	No because just looking around there is paper around and there is nothing removed	L2 & L3
	Mining can also contribute to land pollution, because they deposit their waste on the land after creating whatever that their doing Cans, okay containers and so on... so those are the mostly products that cause now land pollution. Okay now if there is land pollution what effect now can it bring on the environment, if that certain area is polluted? Because many bottles or waste that you have eaten or that you have thrown away and some get rotten what will happen now to those people or living organisms close to that area which is dirty like that?	T1-Ob1
	Now it can cause the extinction of species why? Because these are dirtiness, now it can make those species to die from disease. Because if something is dirty it can cause some specific disease, then these	T1-Ob1

	species are going to die. Now when it dies it will extinct or disappear	
	When the land is polluted is not a good place to live. So when the land is dirty the person can get sick from or become ill	T1-Ob1 & L12
	Whereby we know that flies can go and also be on your food then diarrhoea	T1-Ob1 & L12
	Injury to people exactly the broken bottles sometimes tins which are been cut down. If you don't know that, empty tins can injury you.	T1-Ob1 & L13
	It can also dirty things again can prevent tourists because the tourists, they don't like travelling, walking or visiting the area which is dirty, scattering plastics, bottles and cans wherever, so it affect the tourists not to visit such area	T1-Ob1 & L14
	Anything that you throw on the ground for example that cause harm on the environment. If we are saying anything that does not fit on the land that is what we call litter	L18 & T1-Ob1
	People mostly, in developing countries depend on agriculture in order for them to feed their families, so most of the people they clear the land in order for them to cultivate their different types of crop there. The trees won't be there that will contribute to deforestation	T1-Ob1 & L22

	So that we use it for fuel and charcoal, so they cut down trees and then they burn those trees. After burning those trees they take coal and then put some chemical that they sell in store. There are some certain boxes that we buy from store that they call charcoal	T1-Ob2, L8 & L9
	Out of trees, so the process goes on then they change to be paper. I don't know what type of machine they use so that the paper can be soft. We know that the trees are hard, but paper are out of trees what else that cause deforestation?	T1-Ob2, L8 & L10
	Building kraals, we say in agriculture, okay some of the people keep livestock such as cattle, goats, pigs and so on. These animals also have their own area to sleep or stay. So we cut down trees in order to make their kraals for those animals to be there	T1-Ob2, L8 & L11
	Furniture such as chairs, desks, table for all furniture or most of the furniture there are all made out of the trees. That is why people cut down trees.	T1-Ob2 & L12
	Road construction, so whenever we want to construct road what do we do? If that area contains trees we are going to clear that area in order for the people to construct the road at that specific area	T1-Ob2 & L12
	The stadium, where people do different types of sport activities? Okay let say that if that area contains trees before they started building the stadium, then they also cause deforestation, because	T1-Ob2

	that area is going to be clear, there won't be any trees there, so it can also contribute to that	
	But if you cannot afford, there is nothing that we can do because you cannot afford. So you can still use now firewood and then again, even though you are using firewood make sure you replace it again as we said it earlier, because you cannot afford other source of energy. You cut it for firewood and then you replace for the future use okay	T1-Ob2 & L13
	Okay now when we look at agriculture people they prefer to use slash and burning farming methods. Now people who do agriculture when we look at the process of slash and burn methods what does it mean?	T1-Ob2
	And see that you have cleared, okay when you cut down trees or you clear the land after that all those trees that you have cut down or the bushes you are going to burn them in order for the ash to be manure for your soil so that the soil can be fertilize so that is what we call slash and burn	T1-Ob2
	Okay we know that the plant root they hold soil if there are no enough trees there when wind blow, when the water run maybe heavy rain, then the wind and that running water going to carry along the soil. Soil erosion can be also be able to happen there	T1-Ob2 & L23
	The question said state four negative effects of the rapid population growth on the environment show	T2-Ob1

	in figure four. Okay this word rapidly means fast, when people are growing very fast what problems do they cause on the environment?	
	The word here what we understand, by the word population explosion?	T2-Ob1
	When the population is increasing, yes	P2, P3 & P4
	Soil erosion and depletion of natural resources	P6
	What you see here is loss of wildlife, because on the other side I could see the hunter of animal, but when you look on the next picture there is no animals loss of farming land or fertile soil, as you can see here now people are overcrowded which means there will be no enough space.	T2-Ob1
	They are washing dishes [in the river]	T2-Ob1 & P15
	How did you explain this word here population explosion	T2-Ob2
	Alright she said, the rapid or some time you may say uncontrollable increase of the world population or you can say sudden increase of the world population or fast increase of the world population that is the meaning of population explosion	T2-Ob2, P1 & P2
	What went wrong here? Because of the population, that was increasing so fast and cause problems to the environment. So work with these pictures to give answers. What were the problems created here	T2-Ob2

	If you don't want to say overpopulation, you say overcrowding.	T2-Ob2 & P3
	People will get diseases	P7
	Littering	P8
	Which mean loss of wildlife, the animals have disappeared because of the increase of the population	T2-Ob2
	Washing clothes in the river	P12
	Burning fossil fuel, few example of fossil fuel? Petrol, coal and natural gas	T3-Ob1 & L6
	When they are producing goods they use machinery to be specific factories, they use different machinery. They need energy, they need power, and they use different type of power that can also contribute to air pollution. To be specific looking at Van Eck power station, a power station is a source of air pollution. What type of energy do they produce there? If you tell people stop burning fossil fuel in power station move away from using coal and start using hydro power	T3-Ob1
Environmental problems presented using social and	The challenges and risks to health caused by pollution, poor sanitation and waste	GS, p. 4

scientific rationality		
	Geography provides a scientific knowledge about physical environment and human process which form the basis for cross-curricular education	GS, p. 1
	The terminology, concepts and fundamental to a study of physical and human Geography Geography provides learners with an understanding about the political, social, economic and biophysical dimensions of the world that will enable them to operate effectively in their society and the environment as responsible members of the community	GS, p. 2
	Use local examples to illustrate geographical concepts, issues and process. Case studies on local issues related to syllabus's geographical concepts, issues and strategies can be adapted to appropriate level of learners. Local case studies expose learners to examples of real life problems and helps learners to examine and analyse real life situation	GS, p3
	Us my colleague said then we end up over using or trying to pollute the environment example like water pollution, air pollution	FT2
	Where we normal have argument, when we look at air pollution that also contributes to global warming. When we discuss global and the ozone layer that is where I find more challenging on how	FT1

	<p>can I now real make learners understand how the atmosphere has high temperature or how it contain more temperature, whereby the high temperature cause now what we cause global warming and its effect. With them, they understand that if the UV rays is very high, it make the ice at the polar region to melt so that it can cause flood, that where now we arguing that UV rays is something different form the global warming or something else. It is challenging some of the things that we can now show for them to see exactly or is very hard to explain</p>	
	<p>It's true because some of the things are scientific, so we cannot prove it. When we talk about global warming and ozone layer you just talk it in general but you cannot show it the learners in reality</p>	FT2
	<p>Lack of knowledge about pollution</p>	T3-Ob2
	<p>Not in their factories, in their mining, whatever their extracting, maybe sometimes their washing some minerals. These chemical whatever the waste from the mining sometime they dispose it or they just put it down on the ground that one also can cause land pollution. Now to add on again agriculture also can cause land pollution. Now how does agriculture cause land pollution? We use now different types of chemical, sometimes in order for us to kill pest not to destroy our crop. Now some of the pesticide that we use destroy the nature of the soil, that one also</p>	T1-Ob1

	we call it land pollution.	
	Animals will die if it happens to swallow plastics, because plastics are not food for animals. So that it will cause problem inside the intestine or whatever how you can call in Agriculture	T1-Ob1 & L15
	I just refer to soil, the soil is very much dirty maybe there is a lot of pollution so the trees will not get that good roots, then that tree will be destroy	T1-Ob1, L16 & L17
	When you apply the pesticide when it rain, it will move from the land to the river, because the river....we have fish there also can take fish and for us people and take the fish and eat it	L12
	Methane, methane the gas which can be able to cause fire. Methane can be created out of the decomposition of the waste.	T1-Ob1
	If you use it as fertilizer still it will pollute...the farmers must use organic fertilizer instead of chemical fertilizer	L28
	Can cutting down of trees increase carbon dioxide in the atmosphere? When we have more carbon dioxide in the atmosphere it will cause what or it will lead to what? To global warming	T1-Ob2, L29, L30, L31 & L32
	Human beings need some scientific knowledge to understand how some chemical which they use in other parts of their life end up causing another	T1-Ob2

	effects in other form of life	
	When people overcrowded they contribute carbon dioxide	P7
	That is correct I can see air pollution there, they are producing air pollution	T2-Ob1 & P8
	They are using soap to wash (their clothes) in the river. Soap contain some chemical	T2-Ob1 & P16
	Air pollution very good! I can see air pollution; there you can see it	T2-Ob1 & P7
	Water pollution	P6
	Fish in the river there will die, even when you drink that contaminated water will become sick	T2-Ob2
	Land pollution, we have water pollution, air pollution and land pollution, that is also part of environmental problem. What does pollution means to you?	T3-Ob1
	Any human activity that cause poison to land, under water and air	T3-Ob1 & L4
	So we start with air pollution. What are the sources of air pollution?	T3-Ob1
	These are fossil fuel; burning fossil fuel can emit smoke in to atmosphere that is the cause of air pollution	T3-Ob1

	Cars use fuel, through the pipe what we call exhaust smoke can be emitted in atmosphere that is also a cause of air pollution.	T3-Ob1
	Use of chemical in the farm; example of chemical tell us any example of chemical?	T3-Ob1 & L8
	Do you know what the chemical called herbicide that farmers use it to kill weed, are the same chemical that cause air pollution.	T3-Ob1
	The more gas emitted in atmosphere can destroy ozone layer and it will cause ultra violet (UV)	T3-Ob1 & L17
	Very good that is one of the effects; can you tell us any gas that is likely to destroy ozone layer? CFC	T3-Ob1 & L17
	Do you know what CFC is? What is the cause of CFC? Refrigerator, Spray, Air conditioner and food package, do you know food package?	T3-Ob1, L18 & L19
	We are still on the problem of CFC. What are the problems?	L20
	Very good that is one of the effect it cause greenhouse gases by the way you must know the greenhouse gases, what are they?	T3-Ob1
	Sulphur oxide, CFC, Methane, Nitrogen oxide, Carbon monoxide, remember carbon dioxide and carbon oxide	L21, L22, L23, L24 & L25
	These gases which emitted in the atmosphere they form a thick blanket which we call greenhouse	T3-Ob1

	<p>effect. When the sun heat the short wave radiation is allowed to penetrate this layer. It work like this (the teacher draw a diagram on the chalk board to explain) up in the atmosphere this is the sun, this are what we call short wave, what we call them in term of wave you see them like these short waves are very strong they can pass through this greenhouse layer formed by different gases which is emitted by people whatever activities their doing. Remember the short waves will pass and heat the surface is goes straight. Why does it penetrate the greenhouse blanket? Why do these waves penetrate/pass through?</p>	
	<p>Their short waves, because their very strong and straight from the sun, greenhouse gases cannot block them not to pass through, but the earth will reflect the heat. By reflecting the heat this is what happen, the long waves radiation are weak than the short waves. The long waves reflected from the earth surface now there will go back, what happen will the long waves pass the greenhouse gases?</p>	T3-Ob1
	<p>The temperature in the atmosphere increase which means each every year there is certain percentage increase in the atmosphere. What do we call this? Whereby the temperature in the atmosphere keeps in increasing?</p>	T3-Ob1 & L27
	<p>Global warming still has further effect on the environment, what will happen when the</p>	T3-Ob1

	<p>temperature increases in the atmosphere? Now imagine when the temperature increase everyday what will happen at the end of the day?</p> <p>What happen is that like at the sea side or at the coastal side you can get some ice cap, if the temperature is going high it start to melt and it can cause flood</p>	
	<p>It will melt when the temperature in the atmosphere increase worldwide the ice at the pole region melts, as it will start melting the water will flow in the ocean.</p>	L30
	<p>So one of the effects we cannot go without talking about it is acid rain. Acid rain is one of the problems associated with air pollution. Smoke that come from vehicle exhaust, power station, industries all those gases we called sulphur oxide, nitrogen oxide, those one will react with sunlight in the atmosphere and combine with rain water when it rain, we have what we call acid rain. Acid rain can affect specific things like fish and other plant in the water it can also affects trees and animals</p> <p>We are going to talk about the problem of pollution, what is pollution?</p>	T3-Ob2
	<p>When land or water is polluted by human activities</p> <p>Now you know so many type of pollution, can you mention so that you know? Ground pollution, air</p>	T3-Ob2

	pollution and Water pollution	L1 , L2 & T3-Ob2
	Who can give me any source of air pollution? Burning of fossil fuel Motor vehicle exhaust pipe Burning vegetation Smoke from the factories Development of industries Power station	T3-Ob2, L4, L5 & L7
	Many people are burning the forest or burning of vegetation it will cause carbon dioxide. stop using private transport use public transport, because the vehicle exhaust is emitting carbon dioxide, nitrogen monoxide, sulphur oxide	T3-Ob2, L9, L10, L11, L12, L13, L14 & L15
	Climate change also you mentioned global warming, ozone layer depletion, climate change. Those are the problem affecting us. What even activities that is taking place or burning you must know either you are emitting carbon dioxide, carbon monoxide, sulphur oxide, nitrogen oxide methane and CFC in the atmosphere. When air is polluted is does not direct result in global warming, ozone layer depletion, acid rain or climate change. This is forcing us again to get question like how does global warming occurs. How acid rain does occur? We will start with global warming take note of the following, with the help of the sketch; we will be able to explain how global warming occurs. I will do a simple one (the draw a rough sketch on the chalk board to explain how does it happen), but you must look better. You are here on earth there are many activities that take place. These are building	T3-Ob2

	<p>maybe power station or someone cutting trees or someone driving that are all on the earth at the end of the day anything we are doing here we are emitting greenhouse gases and it form this layer.</p> <p>When is depleted I cannot remember now in Japan where ozone hole is found, that the scientists tell that there is a hole. The effect will talk about it later. When is depleted, because it function is to trap the UV from heating us straight, then it is likely to affect us, so skin cancer and many related diseases.</p> <p>First step: the sun heat the earth and secondly: the earth surface reflects the heat in to the atmosphere. The important thing you must ask yourself is why does the heat from the sun is regarded as short waves, because short waves are strong, because it comes from the sun direct and it penetrate no matter how thick the layer of greenhouse gases. The heat from the sun will just penetrate and we call it short waves radiation. When the earth surface reflect or send the heat back in to the atmosphere this is what happen, it reflect the heat in form of long waves radiation. Long wave radiation is very weak and then it will be trapped by the greenhouse gases. To trap means not to allow some things to pass through, once the heat is trap it will be kept between the earth surface and the atmosphere. The sun heat the earth, then the earth reflects the heat and the</p>	
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	<p>greenhouse gases trap the heat. What will happen in the atmosphere?</p> <p>The temperature in the atmosphere will increase that is what will happen, before I will talk about global warming. If is define global warming what will you say?</p>	
	<p>It is the average increase, when the earth atmosphere gets warmer the temperature will increase, global warming</p>	T3-Ob2 & L21
	<p>Global warming may cause the ice on the Polar Regions to melt and may result in to flood</p> <p>To end it up knows about acid rain as the result of air pollution. Whatever we are doing here that emit nitrogen oxide, sulphur oxide and carbon monoxide in the atmosphere what happen these gases react with sunlight and combine with rain water and cause acid rain. That can affect things like fish in the water and plants in the water</p>	T3-Ob2 & L21 L24
<p>Environmental problem presented as cross border problems</p>	<p>The challenges and risks we face from globalisation including ITC</p>	GS, p. 4
	<p>Has thematic link to other subjects cross the curriculum</p>	GS, p. 1

	A sense of place and relative location on a local, regional and global scale, with special emphasis on Namibia examples	GS, p. 1
	Geography provides learners with an understanding of the risks and challenges in their world that need to be addressed in order to improve the quality of their live and health of the environment	GS, p. 2
	Geography provides learners with the skills and competencies that will both enable them to navigate their world and its risks and challenges and proceed with geographical education beyond JSC phase	GS, p. 2
	_____	FT1 & FT2
	Many goods come in easily disposable contains; such as food in paper or foam packaging etc.	L11
	Now what causes land pollution mostly we are looking at the waste that are been using at homestead	T1-Ob1
	_____	T2-Ob1 & Ob2
	It will cause flood, flood is one of the effect of global warming on the environment The water in the ocean will rise and coastal towns are likely to be flooded that is how it happens	T3-Ob1
	Climate change is one of the affect and climate change can result into severe drought which will	T3-Ob2 & L23

	affect food production.	
	<p>Good coastal town I likely to be flooded because as the temperature increase the ice at the polar regions will melt the water flow in the ocean, the ocean or sea level will rise, then the coastal town will be flooded. We have looked at the climate change result in severe drought and decrease in food production</p> <p>Now it is because of human activities which cause climate change, climate in general can affect us either we will have heavy rainfall or very little rainfall. That is what happen to our rain, it may rain heavily until in May, people can harvest in the past more, but now because of human activities the climate may change , either it rain heavily in Owambo and in Kavango it rain less. That is climate change in it is own can result in flood, when areas are flooded, the water from the river reaches the settlement where people are living and mosquitoes are attracted to stay in standing water that is the breeding area for mosquitoes. Mosquitoes cannot breed in cold/dry area, it breed in warm and moisture areas. The areas should be warm moisture or wet, the reproduction of mosquitoes will speed up, more mosquitoes means that more malaria. So you be bite by mosquitoes because it is more. You have to talk about climate change, periodical flood that provide breeding areas and mosquitoes will be</p>	T3-Ob2

	more and there will speed malaria, you have to give scientific explanation.	

Appendix 5 Analytical Memo 2: problem solving teaching methods in the Geography syllabus and by teachers.

Related to prior knowledge and live experience related	The starting point for teaching and learning is the fact that the learner bring to school a wealth of knowledge and social experience gained continually from the family, the community, and through interaction with the environment	GS, p. 6
	Learning in schools must involve, build on extend and challenge the learner's prior knowledge and experience	GS, p. 6
	Teachers always find it easy to relate their lessons to learners' experiences when they are teaching theme like deforestation, because these learners and their parents is what they do to cut down for firewood and building materials learners will draw from their experiences to understand what is going on	FT2
	Yes if you look at it nicely or if you can just recall now even yesterday when you were walking around on the school ground is the school ground polluted or most polluted?	T1-Ob1
	The government should make the buyers and sellers of tropical wood illegal, meaning now those one who like cutting trees in order for them to sell now it should make that process illegal. In	T1-Ob2

	<p>other way instead of making it illegal we know that some of the people depend on cutting down trees in order for them to get income. It should be able to put up a committee in order for them to limit the number of trees that you cut down and then you can be able to have licence or permission in order for you to cut down a certain number of trees, that will be able to reduce deforestation that we are have in our area.</p>	
	<p>Because they said you must use the diagram. There we see overcrowding, over population is correct, you see air pollution there and also deforestation compare to the first picture.</p>	T2-Ob1
	<p>Identify from the diagram the way in which water in the river is used?</p>	T2-Ob2
	<p>What type of pollution you have come cross or have learned before or that you know?</p> <p>You know we are many people here going to work if every teacher is driving his/her own car how many car that will emit carbon dioxide?</p>	T3-Ob1
	<p>Now you know so many type of pollution, can you mention so that you know?</p>	T3-Ob2
Field based	<p>When learners can allow to find their own way through a topic or area of content</p>	GS, p. 6
	<p>Geography skills to be observe, collect and represent data, analyse and interpret data and present findings</p>	GS, p. 2

	Investigate, asks for, observe, investigate and enquire	GS, p. 2
	Interpret, comprehend, distinguish, interpret, translate data, explain, compare, synthesize	GS, p. 2
	I think there are also some short comings like we don't taking these learners in the field sometime to realize themselves the situation in reality. Ever though we are just making them to be aware that these things are not good like what we do in the class we make sure that the class in clean	FT1
	You know like field work it needs time, but grade10 aaah! I don't think there are field works. I think 15-20 time land transcend that one; you can take learners outside to compare plants that are growing on certain areas. but the teacher can still arrange and then you can make these learners to be at an environment to make some research. The syllabus itself normally hmm not so much happening	FT2
	Sometime about the topic that you be teaching tomorrow, if you know such problem they have it in their environment so you can now send them into the community and find out exactly what lead them to cause that problem and how they can be able to solve it so that they can reduce such problem.	FT1

	Like me in my case what I do normally, I ask them to present their findings. They present to the class to other classmates, they can comment or discussing them, from the teacher's side repeating them now to analyze, to add to their answers that is what I normal do.	FT2
	If the place is close by so you can maybe do it afternoon to walk and reach that place for you to do you activity there	FT1
	_____	T1-Ob1 & T1-Ob2
	_____	T2-Ob1 & T2-Ob2
	_____	T3-Ob1 & T3-Ob2
Literature research	When it is best to let learners discover or explore information for themselves	GS, p. 6
	When there is a particular progression of skills or information that needs to be followed	GS, p. 6
	You can ask them to go through to read and find out the solutions in the textbooks. Some of the solutions are just indicate but are not explaining. Now as the learners are naming that certain solution, they should be able to explain it how do they understand and how to solve such problem.	FT1
	_____	T1-Ob1 & T1-Ob2
	_____	T2-Ob1 & T2-Ob2

	_____	T3-Ob1 & T3-Ob2
Guided Questioning	The teacher must decide, in relation to the learning objectives and competencies to be achieved when it is best to convey content directly	GS, p 6
	When they need directed learning	GS, p.6
	When they need reinforcement or enrichment learning	GS, p.6
	The way we introduced it, in my case, I normally say these environmental problems are normally caused by us, people who are depending on the environment. For everything, as these problems is us who creating these problems, so we must try to find the answer to these problems. As we go in detail, everybody knows that we are talking about environmental problems and then we must find away how to solve the problem we are causing on the environment. To let learners be aware.	FT2
	Then from there I will ask them why they need the environment for. Like mentioning what they use the environment ever purpose for the environment. So I ask them again after using the environment what changes do you see from the original way how you got it and after few years what changes are you see. Then from there, I relate what activities they do on the environment that makes it to change to what you see now.	FT1

	We are looking at problem to problem until all problems are given solution.	FT1
	We try now to direct how the solutions could to be, just to see if they can have any ideas how to use such problem.	FT1
	As a teacher you go in and try to make the sentence more clearly to the learners. Is one of the supports that I give	FT2
	To be kept in to the lesson, maybe to keep them busy now by talking certain things, you explain certain thing, you ask them just for them not stay long listening; they should also talk in the class, that will keep them awake.	FT1
	<p>Now if you are telling me is polluted or not polluted why are you saying that it is polluted or not polluted?</p> <p>What do you think causes land pollution?</p> <p>Can you try to explain that one for us, said for parking people create waste for parking</p> <p>What is recycling?</p> <p>What is all about ignorance?</p> <p>Now to add on again agriculture also can cause land pollution. Now how does agriculture cause land pollution?</p> <p>We are not looking at what can we to reduce land pollution, but what effect can this land pollution bring on the environment</p> <p>Now how can soil pollution kill trees?</p> <p>What will you do so that your land can not be</p>	T1-Ob1

	<p>dirty?</p> <p>Do not throw litter on the ground? What is litter?</p> <p>Throw on the land you have collected the waste from the land. Let make that you collect the waste from school ground then you are going to put it somewhere maybe there far from the people, even if far from the people where are you going to put it on the land or where?</p> <p>What policies?</p> <p>The policy can be introduced now, but who is going to monitor those people who walk around and see that these people are not throw paper somewhere?</p> <p>Who will tell you that pick up and put it in your pocket?</p> <p>But in town there are dust bin, but still people cannot walk a distance until they find that thing in order for them to throw it. What was there reason for the town council to put up those things there why don't they throw in but they throw anywhere, when they are done drinking or eating?</p> <p>Who will call you?</p> <p>Fine? Okay he will just explain, explain to them what you mean by fine?</p> <p>Where will you take those things? Answer where are you going to take it?</p> <p>When they come and take the question where can we put it?</p> <p>After now collecting the rubbish where are they going to take it?</p> <p>That hole is where they're going to dump those things?</p> <p>After paying are you not going to cause any</p>	
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	<p>pollution?</p> <p>But we know that 100% that some of the products we do not recycle it. Where they are going to put it not to cause land pollution? We said here we are looking on a solution on how we can reduce land pollution. Not we are saying recycle and reuse, but then some we cannot recycle and cannot reuse them. -How about such products?</p>	
	<p>Now what make a tree to be important? What is the importance of a tree in our life or to your life?</p> <p>Now we can take the importance of trees and change it to the cause of deforestation, what will be the cause of deforestation?</p> <p>How can agriculture activity cause deforestation?</p> <p>We are there one who cause it so we should also be able to look at what can we do to solve such thing?</p> <p>Replant some of the people don't know what is to replant? Explain more what is replant?</p> <p>To reuse the materials is that what we call as replant? Replant will be a solution, but I want you to explain now what is to replant? Your explanation does not go a long with what you mentioned</p> <p>Apart from replanting what else can we do to reduce now deforestation?</p> <p>No idea, let me give you one point, we said that the cause of deforestation can also be when we cut down trees in order to make firewood. Now for you not to cut down trees to make firewood, what else can you use to prevent not to cut down trees and use it is firewood only thing you can use? What will be you solution at that specific point? Instead for you using firewood what else can you use?</p> <p>What about those people who cannot afford to</p>	<p>T1-Ob2</p>

	<p>use electricity, gas or solar panel?</p> <p>What type of building materials are we going to use here? What problem can deforestation cause if we are unable to practice the solution that we just listed here? What problem can it be able to bring?</p> <p>Soil erosion explains it yourself?</p> <p>How can cutting down of trees increase carbon dioxide in the atmosphere?</p> <p>When we have more carbon dioxide in the atmosphere it will cause what or it will lead to what?</p>	
	<p>The question said state four negative effects of the rapid population growth on the environment show in figure four. Okay this word rapidly means fast, when people are growing very fast what problems do they cause on the environment?</p> <p>The word here what we understand, by the word population explosion?</p> <p>Alright let look now here, state four negative effects what you have there?</p> <p>Alright, suggest two possible solutions to overcome these problems now?</p> <p>Sorry, reduce the number of population, how can we reduce it?</p> <p>Figure 3 show some of the problem associated with water supply in rural areas. The first question I identify from the diagram again not what you know, but from the diagram three purposes which water from the river is used? How these people are using water from there river?</p> <p>The next question now, suggest two ways how</p>	T2-Ob1

	<p>the people living in the village alongside the Kavango river would use water in order to avoid water pollution? So what can you advice the people to do in this case?</p> <p>To avoid, but still not clear to me. Specifically what we would do now if we are to avoid?</p> <p>Explain more uneducated</p> <p>Figure 6 show one cause of deforestation. Who want to remind us what deforestation is?</p> <p>Then identify the cause of this?</p> <p>How did you explain this word here population explosion</p>	
	<p>Alright (ii) state four negative effects of population growth on natural environment as show on the figure</p> <p>So work with these pictures to give answers. What were the problems created here?</p> <p>I think the question is very clear negative impact on the environment. Do you understand? Must be on the environment</p> <p>Suggest two possible solutions to overcome the huge grow of population in the world. The population is so big what should we do? Should we kill some people or what can be done?</p> <p>Maybe the question was not clear to him. We are trying to find ways on how we can reduce the population. That one I don't know how it can fit there, it is not possible</p> <p>Okay the next question, what can be done? What can you advice your people or your family?</p> <p>What is deforestation?</p> <p>Okay the last one identifies the cause, what is the answer?</p> <p>The last question what does the solution? What</p>	T2-Ob2

	can you tell these people to use?	
	<p>Who can define the term pollution?</p> <p>What are the sources of air pollution?</p> <p>Burning fossil fuel, few example of fossil fuel?</p> <p>Use of chemical in the farm; example of chemical tell us any example of chemical?</p> <p>Industry, what you mean by industry?</p> <p>What can be done now in order to solve the problem of air pollution?</p> <p>Good, example of alternative source of energy</p> <p>What are the environmental problems that air pollution can bring?</p> <p>Any problem that you think is associated with air pollution? Before you can start telling people you must use alternative energy sources or you must use public transport if they ask why should we use public transport? Why should we stop cutting trees? What are the problems? We don't see any problem, we have lived in this area, and we had cutting trees and we never experiencing any problem any problem?</p> <p>Can you tell us any gas that is likely to destroy ozone layer?</p> <p>Do you know what CFC is? What is the cause of CFC?</p> <p>When you use spray you make sure it does not have CFC that will affect our ozone layer. We are still on the problem of CFC. What are the problems?</p> <p>It causes global warming, how does it happen?</p> <p>By the way you must know the greenhouse gases, what are they?</p> <p>Remember the short waves will pass and heat the</p>	T3-Ob1

	<p>surface is goes straight. Why does it penetrate the greenhouse blanket? Why do these waves penetrate/pass through?</p> <p>What is the end result now? What will happen in the temperature of the atmosphere?</p> <p>What do we call this? Whereby the temperature in the atmosphere keeps in increasing?</p> <p>Global warming still has further effect on the environment, what will happen when the temperature increases in the atmosphere? Now imagine when the temperature increase everyday what will happen at the end of the day?</p> <p>Who can tell us, because it cannot just start flooding like that there is something happened</p> <p>You know when temperature increase what will happen to the ice?</p> <p>What will happen to the ocean?</p> <p>What is pollution?</p> <p>Water pollution, where does water pollution take place?</p> <p>Who can give me any source of air pollution?</p>	
	<p>If you are telling people stop burning forest or vegetation what effect does it has? Or stop using private transport use public transport, because the vehicle exhaust is emitting carbon dioxide, nitrogen monoxide, sulphur oxide. If you tell people stop burning fossil fuel in power station move away from using coal and start using hydro power. How will you motivate them, what is the problem if they keep on doing this?</p> <p>-When air is polluted is does not direct result in global warming, ozone layer depletion, acid rain or climate change. This is forcing us again to get question like how does global warming occurs. How acid rain does occur? We will start with global warming take note of the following, with</p>	T3-Ob2

	<p>the help of the sketch; we will be able to explain how global warming occurs</p> <p>-To trap means not to allow some things to pass through, once the heat is trap it will be kept between the earth surface and the atmosphere. The sun heat the earth, then the earth reflects the heat and the greenhouse gases trap the heat. What will happen in the atmosphere? Talk to me, what will happen?</p> <p>-If is define global warming what will you say?</p> <p>-Global warming has effects on the environment, what are the effects?</p> <p>-What will cause food production that can be the end result, but what will happen first?</p> <p>-How is the lifestyle of mosquitoes where do they want to be? Who can tell us I want a scientific explanation?</p> <p>-Whatever we are doing here that emit nitrogen oxide, sulphur oxide and carbon monoxide in the atmosphere what happen these gases react with sunlight and combine with rain water and cause acid rain. That can affect things like fish in the water and plants in the water</p>	
<p>Demonstration and experiments teaching methods</p>	<p>_____</p>	<p>T1-Ob1 & T1-Ob2</p>
	<p>_____</p>	<p>T2-Ob1 & T2-Ob2</p>
	<p>_____</p>	<p>T3-Ob1 & T3-Ob2</p>

Appendix 6 Analytical Memo 3: Problem solving steps across the different themes covered in the three classrooms

Teacher s	Problem Solving Steps					
Steps	Step 1: Identifying the issues and sharing ideas	Step 2: Planning and researching (investigating the problem)	Step 3: Analysing and presenting the information	Step 4: Finding possible solutions	Step 5: Taking action	Step 6: Did it work? Change or identify new problem and repeat the process
Teacher 1	Case 1 Land pollution	XXX	Causes and effects Causes -It is when people create unnecessary waste special for packing. -We do not recycle all the waste we create -Because people don't care or they don't know what pollution does on the environment, because they	Suggested possible solutions -Make use of the dust bins -Recycle -Do not throw litter on the ground -Make use of the	XXX	XXX

			<p>don't know what will happen?</p> <p>-Lack of taking the dump in the dust bins</p> <p>-Factories</p> <p>-Okay cans and containers</p> <p>Effects</p> <p>-Pollution can cause the extinction of species</p> <p>-It cause disease</p> <p>-It can injury something like broken bottles</p> <p>-Plastics can cause death of animals, if it happens to swallow it</p> <p>-It can also dirty things again can prevent tourists</p>	<p>people to pay for plastic, when they go in the shop</p> <p>-Educate people about the danger of pollution</p> <p>-Farmers must use organic fertilizer instead of chemical fertilizer</p> <p>-Let the polluters pay</p> <p>-I think they forget about burning</p> <p>-If we can just collect</p>		
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				<p>materials that cannot be recycle and put them on the same place and pick them. At least only that place will be polluted, but the other side where you collected it will be clean. Instead of leaving them around all over it will not attract flies and mosquitoe s as we said. But if</p>		
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				you collect and put them at one place at least you are reducing some		
Teacher 1	Case 2 Deforestation	XXX	Importance, causes and effects Importance -It produces shadow -It releases oxygen that we use for breathing -It provide fruits -It provide medicine -Use for building our home -It provide	Possible solutions -Replant -Use alternative building materials -To recycle some products	XXX	XXX

			<p>firewood</p> <p>Causes</p> <ul style="list-style-type: none"> -Use for building house -Agriculture activity -Cut down for firewood -Fuel and charcoal -Making paper -Building kraals -Cut to make furniture -Road construction -Stadium <p>Effects</p> <ul style="list-style-type: none"> -Loss of nature -Loss of life and plants 			
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			<ul style="list-style-type: none"> -Soil erosion -Increase carbon dioxide in the atmosphere -It leads to global warming 			
Teacher 2	Case 3 Overpopulation	XXX	<p>Effects</p> <ul style="list-style-type: none"> -Soil erosion, deforestation and depletion of natural resources -When people overcrowded they contribute carbon dioxide -It cause air pollution -Overgrazing, overcrowded and bush encroachment -People will get diseases 	<p>Possible solutions</p> <ul style="list-style-type: none"> -Reduce the number of population -Family planning -Educate people about the danger of over population -Later marriage -Have one child - 	XXX	XXX

			-Littering - Desertification	Contraceptive		
Teacher 2	Case 4 Water pollution	XXX	Importance, causes and effects Importance -Washing dishes -Bathing -Fetching water -Washing cloth Causes -People did not learn more how to use water -Ignorance Effects -Fish in the river there will die, even when you drink that contaminated water will become sick	Possible solutions -Avoid washing in the river -Provide tank for animals -Tell people to stop throwing rubbish in the river -People must use big plate to bath -Even bathing, they must use outside the	XXX	XXX

				<p>river</p> <p>-They must stop washing dishes in the river</p> <p>-People must use public toilets at the villages.</p>		
Teacher 2	Case 5 Deforestation	XXX	Causes -Building materials	Solutions -Use bricks	XXX	XXX
Teacher 3	Case 6 Air pollution	XXX	Sources and effects -Burning fossil fuel -Use of chemical in the far -Motor vehicle exhaust pipe -Burning	Possible solutions -By using alternative energy sources -Stop using private transport use public transport	XXX	XXX

			<p>vegetation</p> <ul style="list-style-type: none"> -Smoke from the factories -Development of industries -Power station <p>The effects</p> <ul style="list-style-type: none"> -The problem it will lead to global warming -It will lead to ozone depletion -It will cause acid rain 			
Teacher 3	Case 7 Global warming	XXX	<p>Causes and effects</p> <p>Causes</p> <ul style="list-style-type: none"> -Greenhouse gases goes in to the atmosphere it cause global warming <p>The effects</p>	<p>Possible solution</p> <ul style="list-style-type: none"> -Use products that are CFC free -By using alternative energy 	XXX	XXX

			<p>-It will reduce food production</p> <p>-Will cause climate change and climate change will cause drought</p> <p>-May result in to flood</p> <p>It will increase malaria</p>			
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Appendix 7: Sample of lesson plans

13-03-2012

Topic: The Deterioration of the Namibian Environment

Objectives: Investigate the reasons for the deterioration of the environment and search for possible solutions.

Basic Competences: Describe pollution of land and suggest solutions for the problems.

Teaching aid: Textbook

Teacher activities	Learner activities
Introduction Explain to learners what is land pollution.	- Listen
Lesson development Ask learners if the school ground is polluted or not polluted? The choice should have reasons. Emphasize learners views. Discuss with learners what can be done to reduce land pollution.	- Answer verbally - Learners take part in the discussion.
Conclusion Encourage learners to solve a problem	- Listen carefully

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Appendix 8: Sample of worksheet

ECOLOGY

2 (a) Study Fig. 4 which shows the effect of the population explosion on the world



Fig. 4

- (i) What do you understand by the term *population explosion*? [1]
- (ii) State four negative effects of the rapid population growth on the natural environment as shown in Fig 4. [4]
- (iii) Suggest two possible solutions to overcome the huge growth of population in the world. [2]

Appendix 9: Requests for access to conduct a study at the school



Ruuga Combined School

P.O Box: 2134, Rundu

Tel/Fax: 066 257 102

05 February 2012

The Principal of

Combined School

Rundu

Dear: Sir

Re: Permission to conduct research at your school

I am a part time student pursuing a Master Degree in Education at the Rhodes University and hereby write to request for permission to conduct a research at your school. I intend to include one of your teachers (Grade 10 Geography teacher) in a focus group discussion and carry out one week classroom observation.

I am conducting a research on how do teachers present environmental problems and implement problem solving methods in the Grade 10 Geography syllabus? Therefore, I would like to work with your teacher in my research project. Any other detailed will furnished to the school as shall be required

Your cooperation is highly appreciated.

Yours in sincerely

Herman K. Zokka