

**Implementation of Environmental Learning in the NSSC Biology curriculum  
Component: A Case Study of Namibia**

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## ABSTRACT

In the context of ecological crisis and environmental deterioration, teaching about environmental issues and the preservation of the world's environment has become increasingly important across the globe (Chi-chung Ko & Chi-kin Lee, 2003). Of the various subjects taught in secondary schools, Science is often perceived as one that can make a significant contribution to environmental education. It is in this light that the study has looked at how Grade 11 and 12 Biology teachers in the Namibian context implement Environmental Learning (EL).

This study was constituted as a case study of two schools in Windhoek, in the Khomas region. The study investigated the implementation of EL in the Biology curriculum focusing on the constraints and enabling factors influencing the implementation. This study employed qualitative methods, specifically semi-structured interviews, classroom observations and document analysis in its investigation of EL implementation. Purposive sampling was done and piloting of interview and observation schedules was used to refine the schedules. Ethical issues were taken into consideration throughout the study. The key findings from the study are as follows:

- Teachers' knowledge and interest in environmental education influence how teachers facilitate EL;
- There is a mismatch between EL theories and practice;
- Teaching of EL is mainly informed by the syllabus and not other curriculum documents,
- Current assessment policy and practice impact on EL; and
- Possibilities exist for improving EL in Namibia's Biology curriculum.

These key findings have been used to make recommendations for the study which are as follows:

- Strengthen the subject content and interest of teachers;
- There should be a match between EL theories and practice;
- Reorient curriculum documents and other learning support materials used for EL;
- Change in assessment approaches; and
- Translate constraints of EL into enablers.

The study concludes by calling for further research into EL pedagogies. This can be used to improve EL implementation in the region where the study was situated.

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## **CHAPTER 1**

### **OVERVIEW OF THE STUDY**

#### **1.1 CONTEXT OF THE STUDY**

Namibia became independent from the apartheid government of South Africa on the 21<sup>st</sup> March 1990. Before independence, education in Namibia was fragmented and divided into eleven educational authorities on the basis of race, colour and economic status (Amukugo, 1993). Amukugo further indicates that the curriculums in schools inherited from the apartheid era were not widely accepted as they were primarily examination driven, not skills oriented, teacher-centred and not sensitive to the needs of Namibians. The curriculum did not meet the challenges of the developing world, nor did it provide for contextual teaching and learning. According to Kanyimba (2002), even with this fragmented structure, environmental education was accorded a place in the broad curriculum for schools in different ethnic groupings. General Science was a subject that carried environmental education components for the Junior Secondary phase while in the Senior Secondary phase, Biology and Geography were the main carrier subjects. The syllabi for these subjects were theoretical in nature and not fully understood.

One of Namibia's biggest challenges after independence in 1990 was to build a new educational system where quality education for all is a cornerstone. There was a need for education that is relevant to Namibia, adaptable to the changing needs of Namibian society and determined by Namibians themselves (Namibia. Ministry of Education [MoE], 2009). Education reform processes were started by the Ministry of Basic Education and Culture (MBEC) (now known as the Ministry of Education or MoE), to contribute towards addressing issues of injustice and inequality that prevailed under colonial and apartheid rule (Amukugo, 1993). This process was not only to address past injustices and inequalities that prevailed but also an attempt at setting Namibia on the path to more appropriate development and sustainable living. The Ministry of Education started a programme of refining the policy noting that, 'education for all should encompass four primary goals; namely, access, equity, quality and democracy' (Namibia. Ministry of Education and Culture [MEC], 1993:32). These primary goals are addressed in different ways. One of these goals, for example democracy, is being addressed through a learner-

centred education approach (see Section 2.8.1 for further discussion on learner-centred approaches).

The National Institute for Education Development, a department under the Ministry of Education was established in 1990. The National Institute for Educational Development has the continuous task of ensuring that education in Namibia is developed and improved in accordance with the latest developments in education and the needs of the people in Namibia. Throughout basic education themes, which are essential, are organized across the curriculum, these are: HIV/AIDS, health and wellness, human rights and democracy, Information and Communication Technology (ICTs) and Environmental Learning (EL).

Each of these themes deals with particular risks and challenges in Namibian society, such as the risks and challenges we face if we do not care and manage our natural resources, risks caused by HIV/AIDS, risks caused by pollution, poor sanitation and waste and risks we face from globalization. Learners need to understand the nature of these risks and challenges and how they will impact our society and the quality of life of our people now and in the future. They must understand how these risks and challenges can be addressed on a personal, local, national, and global level and how they can play a part in addressing these risks and challenges in their own schools and local communities (Namibia. MoE, 2009).

Integration of key themes across the curriculum aims at creating a knowledge-based society that is literate, confident, independent, numerate, multi-skilled and compassionate with respect for the environment and the ability to participate in society as critical and active citizens. The initiative to integrate environmental education in the basic education policy was to enhance the quality of education in Namibian schools and the quality of life of the Namibian people (Namibia. MoE, 2009). However, in spite of these laudable initiatives, Uugwanga (1998) observes that opportunities for education in public schools are still unequal among racial groups even after independence. This is despite over 20 years of implementing the 'Towards education for all' (Namibia. MEC, 1993) policy that states that all learners have a right to access basic quality education; irrespective of race, gender, ability and socio-economic background.

The quality of education received by the learners is determined by among others the conditions of schools, better trained teachers and improved methods of teaching and learning (Namibia.

MoE, 2009). This has contributed to the choice of this study to investigate the constraints and enablers of environmental education (see Section 4.2.2, Section 4.3.4 and Section 4.4.3).

Since independence in 1990, the Namibian Government has given high priority to environmental concerns. Statements within the Constitution and Vision 2030, Namibia's long term plan (Namibia. MoE, 2009) stresses that the promotion of environmental education among children is important for Namibia's development. According to the Office of the President (2004), Article 95 of the Namibia Constitution 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 (p.3).

Article 95 declared that all people of Namibia be provided with access to environmental education through both formal and non-formal education. Thereafter, the Ministry of Education pledged to make environmental awareness one of its stated goals. The Namibian Ministry of Education (2009), lists development of environmental education and population awareness as a specific aim (section 3.10), and promotes the development of understanding, responsibility and practical involvement in striving towards ecological sustainability and improved quality of life. Namibia's vision 2030 aims at producing "An environmentally sustainable society" (Namibia. MoE, 2009:8).

The Namibian education system is described in 'Towards education for all'; the goal, aims, competencies and core skills, and key learning areas have been identified in relation to Vision 2030 as a curriculum for the future. Vision 2030 sees Namibia as developing from a literate society to a knowledge-based society, a society where knowledge is constantly being acquired and renewed, and used for innovation to improve the quality of life. "A knowledge-based society is one where knowledge is created, transformed and used for innovation to improve the quality of life" (Namibia. MoE, 2009:2). Vision 2030 aims for caring, information, healthy, democratic, productive, and environmentally literate society.

The establishment of the Namibia Environmental Education Network (NEEN) has been a milestone in the history of environmental education in Namibia. This national network facilitates information sharing in environmental education. According to the Namibian Environmental Education Network (1999) the NEEN policy aims at empowering Namibians to take actions that will contribute to environmental sustainability. It maintains that:

Namibia will actively encourage, support and implement environmental education as a means of achieving and fulfilling Article 95 of the constitution. Environmental education should aim to empower Namibians, from all sectors, and to critically evaluate environmental information and options, to make informed decisions, and to take actions that will contribute to the goal of environmental and economic sustainability (p.1).

The history of environmental education in the curriculums has further been influenced by a number of internationally funded development projects including the Life Sciences Project, the Enviroteach Project and the Support Environmental Education issues in Namibia (SEEN). These three projects were substantive international development assistance interventions in the context of apartheid educational transformation in Namibia. The Life Sciences Project started in 1990, and gave impetus to the Enviroteach Project, which started in 1992, and later the SEEN project. The Life Sciences Project effectively created a new subject in the Namibian educative system, while the Enviroteach project and the SEEN project gave attention to teacher development and supporting EL in the curriculum reform process. A vast amount of money (approximately 90 million Namibian Dollars on the Life Science project to over 550 000 learners) was spent on these projects by the Danish government over a 20 year period making this a substantive national intervention (Kristensen & Andersen, 2001). Similar investments were made in Lesotho and South Africa, but the Namibian intervention was far the most substantive. These projects and their specific influences are discussed further in Section 2.4.2.

Environmental education is a cross curricular concern (see Section 2.4.2), but this study will only focus on the Biology curriculum. According to the Namibian Ministry of Education (2009), the Biology curriculum is an introductory, practical based course designed to study living organisms and their physical environment. The emphasis of Biology is on developing the ability to ask questions, to observe, to experiment, to measure, to problem solve, to gather data and to communicate findings. The Biology curriculum is designed as a two year course (Grade 11 and 12) leading to examination after completion of the Junior Secondary (Grade 10) Certificate. In

Namibia, Grade 11 and 12 is the final phase of formal education. This phase follows the Ordinary and Higher Namibian Senior Secondary Certificate curriculum (NSSC). The Biology curriculum for Grade 11 and 12 is the context in which the study will be carried out, as it is the area of my specialization in which I would like to broaden my knowledge.

## **1.2 MY ROLE AS A BIOLOGY TEACHER AND MY INTEREST IN THE STUDY**

I have worked for the Ministry of Education as a Natural and Social Science teacher for six years, and taught Grade 8 to 12. The school at which I have worked is situated in Windhoek, in the Khomas region. The school offers Grade 8 to 12 and offers a variety of fields of study to cover 1000 learners, has over 40 teachers. Because of my passion and interest in EL, I have been involved in extra mural activities, including facilitating the environmental club and the My Future is my Choice programme (an HIV/AIDS programme). All these extramural activities were aimed at promoting environmental awareness and health and sustainable development in and around the school. The limited exposure to EL I have encountered during my studies and experience as a teacher, has created an interest in and curiosity about EL, motivating my involvement in environmental education and sustainability processes.

The interest in EL resulted in my enrolment for a certificate course and honours degree in education with specialization in environmental education as a way of understanding environmental issues both at global and local level. During the certificate level, I was keen on addressing the loss of biodiversity at the local level and as a result I have developed an awareness booklet on the loss of biodiversity for the Havanna community in Windhoek, Namibia. During the honours degree course I came across some insights into how the history and aims of environmental education have influenced the curriculum and how EL is treated in the formal and non-formal sectors as a response to the complexity of environmental problems and concerns at global, national and local level. It is also within my honours course that I came across a quote from Loubser (2008:27) that says:

We have only one planet to live on; we and our children may still be able to prevent the destruction of our planet. Please devote your attention to convincing students in your classes of the importance of this fact. The implementation of an environmentally directed teaching approach in ordinary classroom teaching is not only worthwhile, but also rewarding.

The above quote has since made me question our role as teachers and how we can educate learners to become environmentally literate citizens. This motivated my interest in carrying out this study.

In the light of the above information and the observations of Ketlhoilwe (2008) who stated that to strengthen and broaden teaching and learning approaches for relevant quality education in environmental and sustainability education in southern Africa, epistemological and pedagogical concerns and contextual issues need to be researched. The range of research aspects should point to a curriculum that is oriented towards knowledge building, methodological enhancement and situated learning. Nsubuga (2008) states that environmental education integration in the curriculum remains under researched and undocumented. These two recommendations from regional research have contributed to my interest in choosing to do this study, which is to understand how Biology teachers promote environmental learning to ensure that learners gain knowledge and skills to achieve Vision 2030. Rickinson and Lundholm (2008), however, observed that for much of the last decade within the field of environmental education research there has been insufficient attention given to EL processes, or investigations into what Scott and Gough (2003:14) described as “learning which accrues from an engagement with the environment or environmental ideas”.

Further motivation for this study was provided by Robertson and Krugly-Smolkska (1997) who explained that over the last 30 years individuals and interested groups have raised concerns about the effect of human activities on the environment. In response to this, some schools refocused their curriculum to include EL. In addition to this, some School Boards and interested groups have made a variety of resources available to teachers. But, according to teachers there is still a gap between many of the expectations of EL and what they are able and willing to do within their own teaching practice (*ibid.*). This study sought to investigate how the teachers integrate EL within the Namibian Senior Secondary Certificate (NSSC) Biology curriculum. Through this study, I explored how this was done in two secondary schools in Windhoek. My particular interest was to investigate whether teachers do indeed integrate EL within the Biology curriculum and the constraints and enablers thereof.

As discussed in Chapter 6, the results of the investigation helped me reflect on my own teaching and has contributed to a broader understanding on how to promote EL and improve my effectiveness as a Biology teacher. The results of the investigation also contributed to a broader understanding and to the existing knowledge of EL in the Biology curriculum. The study provides in-depth insight into what happens in the selected Biology classrooms regarding EL practices. The study findings helped me to generate recommendations regarding the implementation of EL which might be used by other teachers or the Namibian Ministry of Education in curriculum planning to improve the EL implementation processes in secondary schools, for the benefit of Biology teachers and learners.

### **1.3 NAMIBIAN DEMOGRAPHIC INFORMATION**

According to the Namibian National Planning Commission (2011), Namibia's population was estimated to be 2,147, 585 in July this year (2011). This estimate explicitly takes into account the effects of excess mortality due to HIV/AIDS; this can result in lower life expectancy, higher infant mortality rate, higher death rates and lower population growth rates.

Namibia is a middle-income country whose considerable successes rest on a strong multiparty parliamentary democracy that delivers sound economic management, good governance, basic civic freedom, and respect for human rights. At independence in 1990, Namibia inherited a well-functioning physical infrastructure, a market economy, rich mineral resources, and a relatively strong public administration. However, the social and economic imbalances of the former apartheid system have left Namibia with a highly dualistic society. The structure of the economy has made job creation difficult, and poverty and inequality remain unacceptably high. These key challenges are at the top of the government's development agenda (Namibia. Ministry of Environment and Tourism [MET], 2002).

According to UNDP (2007), Namibia has made significant progress in addressing the structural problems: access to basic education has become more equitable and primary health care services are widely available. Access to safe water and sanitation has improved, and sound public policies are helping to lay the foundation for gender parity and new programmes have been launched to protect the country's environment and natural resources. Namibia not only maintains a social safety net for the elderly, disabled, orphans, vulnerable children, and war veterans, but also has a

Social Security Act that provides maternity leave, sick leave, and medical benefits for the population. Nonetheless, human development challenges persist. Although Namibia is on track to meet the Millennium Development Goals on education, environment and gender, it faces daunting challenges in combating the HIV/AIDS epidemic, making it especially challenging to meet Millennium Development Goal Six.

#### **1.4 DEVELOPMENT CHALLENGES**

Although Namibia has sustained a noteworthy track record on economic growth and macroeconomic stabilization, certain daunting development challenges remain. In particular, while poverty rates have declined since independence, Namibia is among some of the least equitable countries in the world. Thus, a central policy challenge in Namibia is to achieve higher rates of growth, create jobs, alleviate poverty, reduce inequality, and raise living standards. Similarly, despite a decline in HIV prevalence rates, which have fallen from 22 percent in 2002 to 17.8 percent in 2008, HIV infections remain a serious concern. Namibia also has one of the highest tuberculosis prevalence rates in the world at 765 per 100,000 with some regions reporting tuberculosis rates as high as 1,000 per 100,000 (Namibia. MET, 2002).

## 1.5 RESEARCH SITE

Namibia is on the Atlantic coast of southern Africa. It is divided into thirteen political and educational regions. The regions are Hardap, Caprivi, Oshana, Omaheke, Kunene, Ohangwena, Omusati, Karas, Erongo, Otjozondjupa, Oshikoto, Khomas and Kavango (see the regions in the figure below).

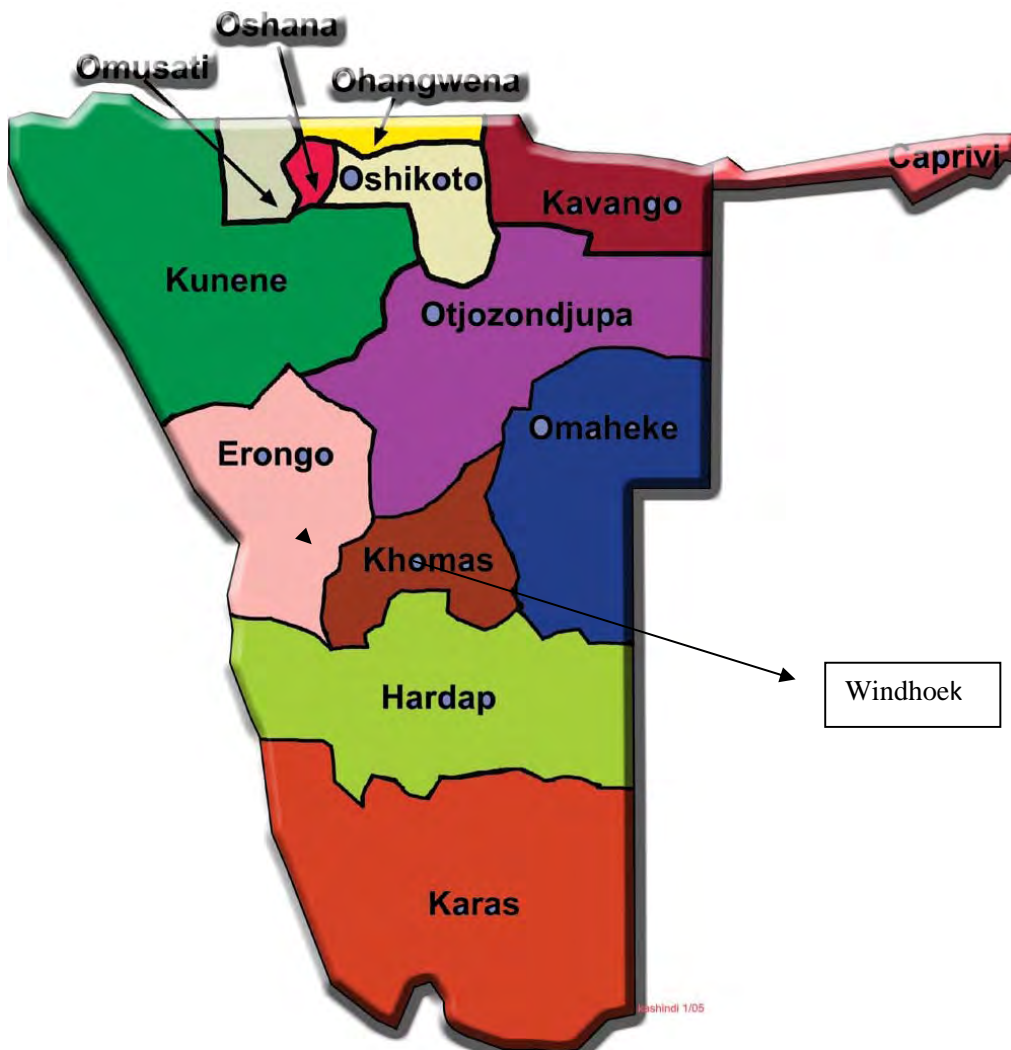


Figure 1.1: Regions of Namibia

[Adapted from original map by Namtranslations services, 2010]

This study was conducted in the Khomas region. The Khomas region is in the central part of Namibia, and is located on the *Khomas Highlands* plateau area, and contains the capital city, Windhoek (see Figure 1.1). The Khomas region has well-developed economical, financial and trade sectors and occupies 4.5% of the land of Namibia, but has a population of 15%, (of the Namibia total population which is estimated to be 2, 147, 585). The majority of people in the Khomas region live in urban areas. The children are well taken care of and are given an adequate education. The Khomas region has one of the highest employment rates comparative to other regions in Namibia. The lifestyle of the people in the Khomas region is standard in relation to other regions (Namibia. MoE, 2009). Due to its relative size, Windhoek is even more than many other national capital cities, the social, the economic and cultural centre of the country. Nearly every national enterprise is headquartered there.

There are about 1500 schools in Namibia, of which about 100 are privately owned. The Khomas region has 104 public schools and 23 private schools. The Khomas region being the central region and highly populated, has the following interventions to improve education:

- Adequate educational resource services,
- Extended working hours except Fridays, or those days preceding public holidays or long weekends – for compensatory teaching, extra mural activities or to prepare lessons for the following day,
- The region engages in-service training for teachers to improve the quality and performance of all schools, as well as to enhance quality and promote a culture of critical thinking, problem solving, discipline and respect, and
- Performance evaluation systems designed to improve teachers' professionalism and work towards a closer supervision and monitoring of schools to achieve a high degree of accountability and panel school visits (Namibia. MoE, 2009:17).

## **1.6 THE STUDY GOALS AND RESEARCH QUESTIONS**

The **goals** of this study are:

- To gain insight on how EL is promoted within the Biology curriculum
- To understand what influences EL in the Biology classroom and

- To understand the enabling and constraining factors influencing EL in the Biology curriculum.

The following **research questions** helped me achieve the above goals:

- How is EL facilitated in the Biology classroom?
- What influences the implementation of EL in the Biology classroom?
- What factors are enabling or constraining EL in the Biology curriculum?

## **1.7 OVERVIEW OF THE CHAPTERS**

The study report comprises six chapters, and in this chapter I will give the summary of each of the six chapters.

**Chapter 1** gives a brief introduction to the study. The chapter provides the context of the study and an overview of the area in which the study took place. The chapter details my role and interest in the study. The chapter further provides information on the purpose and goals of this study.

**Chapter 2** reviews the literature on EL within the curriculum in the global, regional and national context. The chapter also provide a conceptual framework of the study.

**Chapter 3** provides a description of the research methodology. The chapter discusses the interpretive case study method deployed and the data generation techniques used. Issues of ethics and trustworthiness are also discussed in this chapter.

**Chapter 4** presents the data generated from the semi-structured interviews, lesson observations and document analysis. The chapter also highlights emerging categories from the processed data.

**Chapter 5** discusses the findings, using a set of analytical statements. These provide further perspectives on the issues highlighted in Chapter 4. In this chapter I make an attempt to make meaningful knowledge claims related to the research questions as outlined in Chapter 1.

**Chapter 6** concludes the study by providing a summary of the study, recommendations arising from the study, and recommendations for further research.

## **1.8 CONCLUSION**

This chapter started by providing a detailed description of the context of study. The chapter further described the reasons for feeling motivated to carry out such research, particularly my desire to investigate the implementation of EL in the Namibian grade 11 and grade 12 Biology curriculums. The chapter further provided the demographics and history of the research site and the underlying factors that informed this research (*the research interest*). The research goals and research questions are presented in the sixth section of the chapter. Finally the chapter provided a brief overview of the study as a whole, outlining the different chapters of this research report. In the next chapter I provide further insight into the context of the study and its theoretical underpinnings.

## **CHAPTER 2**

### **CONTEXTUAL AND THEORETICAL FRAMEWORK**

#### **2.1 INTRODUCTION**

In this chapter I seek to review the literature, in order to strengthen the theoretical perspectives of this research. I review literature on the broader context of EL in formal education; the implementation/pedagogical practices of EL within the curriculum in different contexts and the influences thereof. I further seek to review literature on barriers and opportunities as these reflect my interest in enabling and constraining factors for support of EL in the curriculum. In addition, literature on Pedagogical Content Knowledge (PCK) is reviewed in order to help me understand EL implementation in the selected Biology classrooms.

#### **2.2 CONCEPTUALISATION OF ENVIRONMENTAL EDUCATION AND ENVIRONMENTAL LEARNING**

##### **2.2.1 Environmental education**

Environmental education as an approach to all education originated more than 30 years ago. “Now it has gained worldwide recognition forming the basis of major national and international environmental strategies...” (Fröhlich, 2006:33). Since then, the concept has been given numerous definitions and labels. However, in this context, the study will look at environmental education from the vision of the Ahmebadad Declaration of 2007 produced at the fourth International Conference of environmental education, to mark 30 years of international environmental education. It states that:

Our vision is a world in which our work and lifestyles contribute to the well-being of all life on Earth. We believe that through education, human lifestyles can be achieved that support ecological integrity, economic and social justice, sustainable livelihoods and respect for all life. Through education we can learn to prevent and resolve conflicts, respect cultural diversity, create a caring society and live in peace. We can learn from indigenous and traditional patterns of living that respect and honour the Earth and its life-support systems and we can adapt this wisdom to our fast-changing world. We can make individual, community, national and even global choices with due consideration for the collective good. Individuals including youth, civil society, Governments, businesses,

funding partners and other institutions can appreciate that their daily actions can shape a viable future of which all can be proud (UNESCO, 2008:1).

The Ahmedabad Declaration 2007 is the fourth international conference on environmental education which was held in Ahmedabad, India in 2007 within the framework of the UN Decade on Education for Sustainable Development (DESD). The Ahmedabad declaration builds on the first three international conferences of environmental education and calls for education processes that are relevant, responsive and accountable. According to UNESCO-UNEP (1988), the first set of international recommendations to guide environmental education was developed in Tbilisi, Georgia in 1977. The Tbilisi Declaration recommended that environmental education should be life long, integrated, active and inclusive. The conference also recognized the complex and multi-dimensional nature of environmental issues and the need to investigate the root causes of environmental problems. In 1987 recommendations of environmental education were reviewed in Moscow, and focused on institutional strategies and action plans to strengthen environmental education. The third international conference was held in Greece in 1997 which debated the role of environmental education in contributing to sustainable development. Following the World Summit on Sustainable Development in 2002, a UN Decade on Education for Sustainable Development (2005-2014) was launched, based on recommendations of Agenda 21, Chapter 26. The fourth international conference on environmental education was then the Ahmedabad declaration (*ibid.*).

According to UNESCO-UNEP (1988), the Ahmedabad declaration reaffirms recommendations made by the third international conference. Among the recommendations made by the Ahmedabad conference are the following; to stimulate learners to achieve sustainability, urge them how to respect and live within the limits of nature and to evolve social, production, technological and economic systems that are creative, innovative, equitable and sustainable. The Ahmedabad declaration recommends the promotion of education that builds capacity to engage critically with contemporary development discourses and practices that nurture and strengthen dialogues and advocacy skills. The Ahmedabad declaration also encourages the use of evaluation practices designed to be a valuable learning process for all involved, and employ pedagogies in schools as a means of integrating environmental education and ESD principles and transformative learning approaches across the entire curriculum and all the aspects of schools.

Some of these recommendations are reflected in the Biology syllabus aims (see Section 2.5) and assessment objectives (see Section 4.2.1.2).

According to Loubser (2008), environmental education is often associated mainly with the natural environment and not with social, political and economic concerns. One of the earlier critiques of environmental education was that it has not taken a critical enough stance on the political, social and economic systems that are responsible for the environmental crisis. This has, however, been widely addressed by environmental education scholars such as Fien (1993); Gough and Robottom (1993) and many southern African environmental education scholars such as (O'Donoghue, 1993; Lotz-Sisitka, 2004) who have substantively developed the field of environmental education from a critical perspective. UNEP (2006) supports this development in the field of environmental education, by noting that, resolving environmental issues requires social, cultural, economic and political solutions (amongst others).

Monroe and Kaplan (1988) note that environmental education aims at creating citizens who can help resolve environmental issues. Efforts to achieve this goal have created curricula that sensitize learners to nature and raise awareness about environmental issues. Elements important in solving environmental problems are; knowledge of the environment and its related concerns, skills in action taking, sense of responsibility and commitment (*ibid.*). Also emphasised by O'Donoghue (1993) and Jensen and Schnack (2006) is the idea of using action oriented approaches to create awareness, foster knowledge and promote participation in environmental education. It is thus also relevant to investigate whether Biology teachers consider these elements of solving environmental issues during their classroom practice.

### **2.2.2 Environmental Learning (EL)**

The Ministry of Columbia (2007:3) defines EL as “a range of approaches to environmental issues including environment education, ecological education and education for sustainable development”. The Ministry of Columbia (2007) notes that EL occurs when learners engage with content that pertains in some way to the environment (not just natural or physical) or environmental issues. Drawing on Chi-chung Ko and Chi-kin Lee (2003), for the purpose of this study, EL will be defined as the learning associated with teaching of environmental issues within

the curriculum, where learning outcomes relating to knowledge, skills and attitudes are environmentally focused. According to Lundholm and Plummer (2010), EL can enable learners to develop environmental ethics, accountability as well as responsibility. Support Environmental Education in Namibia (SEEN) (2005) states that EL in Namibia focuses on the skills, values and attitudes informing decisions and actions rather than just the 'facts'. Jensen and Schnack (2006) also see environmental education as a development chain of competence for decision making and action taking.

The Ministry of Columbia (2007) clearly differentiates between environmental education and EL by stating that, environmental education is a way of understanding the environment and how humans participate and influence these environments. EL is facilitated through environmental education by incorporating environmental themes into teaching and learning. Such themes in Biology are for example, energy flow, human influences on the ecosystem and conservation of species (see Section 4.2.1.1). Learners should understand both how and why the environment has an impact on their daily lives and what kind of impact their daily lives have on the environment.

Rickinson and Lundholm (2008) point out that despite the fact that EL has become a feature of many countries' formal education systems, very little is known about what such provision looks like. Rickinson (2006) argued that most environmental education research has overlooked the meaning of learning in environmental education, learning processes and apparent reluctance to engage with learning theory; thus he suggested that we need to think of what 'learning' means in environmental education, "we need to think carefully not only about 'the what' (i.e. foci and outcomes) but also about the 'the how' (i.e. processes) of environmental learning" Rickinson, 2006:448). On a positive note, Rickinson reported that there have been signs of positive development and growing recognition of the centrality of learning within debates about sustainability, and there are also encouraging signs in an increasing number of studies that take seriously the way learners are making sense of their experience in environmental education and evidence of efforts to explore how more general theories of learning might inform research in environmental education. According to Loubser (2008), we have had EL for over 30 years now, but the environmental crisis continues to get worse. Investigating how selected Biology teachers in this study implement EL has the potential to illuminate some aspects of these questions.

Stewart (2001) explains that EL is a vital component of efforts to solve environmental problems. EL must constantly adapt to the rapidly changing social and technological landscape while ensuring that it stays relevant to the needs and interest of the community. He further explains that, “EL has become increasingly difficult to understand and to evaluate, yet environmental issues are more often expressed in ‘sound bites’ than explained by sound reasoning” (Stewart: 283). New knowledge and techniques are required to strengthen the standards of EL and reduce environmental issues. Moreover, reasonable treatment of environmental concerns often falls prey to the political agendas of those who have a vested interest in unsustainable, resource-extractive approaches to economic development. Stewart (2001) concludes that the challenge is to express the complexity of modern environmental issues in ways that are understandable and inviting. At the same time, it is necessary to ensure that the curriculum continues to play an important role in explaining and evaluating environmental issues and forging solutions to those environmental problems.

### **2.3 NAMIBIA’S SOCIO-ECOLOGICAL ISSUES AND ASSOCIATED RISKS**

According to Enviroteach (1995), Namibia is the driest country south of the Sub-Sahara with no perennial rivers except at the borders. Namibia experiences unpredictable annual rainfall except in the northern parts of the country. Its environment is semi-arid and fragile, yet the majority of its population is dependent upon the land for living. Prior to independence many people lacked appropriate skills and knowledge for sustainable living. This led to some cases of environmental mismanagement, where in certain areas of the country environment degradation and habitat destruction such as deforestation, wastelands and bush encroachment is clearly visible. Immediate attention was therefore needed to create an environmentally literate and responsible nation, which understood the consequences of the past and who have the competence to take necessary action to live sustainably for the benefit of the present and future generations. In addition to the above, Namibia also faces political, economical and social problems that contribute to environmental problems, which have been briefly discussed in Chapter 1.

According to SEEN (2005), every year Namibia’s soil continues to blow off the land leaving the land degraded and everyone poorer. Overgrazing and tree cutting in areas of marginal agricultural productivity threaten habitats and wildlife. Off the coast, overfishing by commercial interests continues to erode traditional Namibian livelihoods. HIV infections and deaths from

AIDS continue to rise, placing ever-increasing stress on the resources of the communities. Water use is inefficient and inequitable, and the productivity of the land continues to be held back by inappropriate distribution, tenure and use. The loss of biodiversity threatens livelihoods and future development (*ibid.*). Some of these named environmental issues resonate with UNEP (2008) who also identifies and describes the following environmental issues as being common in Namibia:

- Land degradation and desertification - desertification is the foremost environmental problem in Namibia. Despite the scarcity of arable land, almost half of the population is involved in agriculture. Evidence of desertification includes declining groundwater levels, soil erosion, reduced soil fertility and loss of woody vegetation.
- Aridity and water scarcity - water availability is the single greatest factor limiting development in Namibia. Extreme temporal variability and uneven spatial distribution of water resources constrain livelihoods. There are limited perennial surface water sources. Groundwater accounts for roughly half of all water consumption.
- Threats to loss of biodiversity - Namibia is home to abundant biodiversity, including unique desert-adapted ecological communities and productive coastal fisheries. The Succulent Karoo of the Namib Desert is one of the few arid biodiversity hotspots in the world. It contains the richest collection of succulent flora. Threats to this region include grazing, agriculture, and mining. Namibia also has one of the largest remaining populations of black rhinos, a highly endangered species threatened primarily by poaching. Namibia's fisheries are some of the most productive in the world (UNEP, 2008:257-257).

Confronted with these challenges, Namibia is working towards meeting Environmental Sustainability as defined by the United Nations Millennium Development Goals 7. Although Namibia has seen an increase in the access of its people to improved water sources, the country's primary environmental concerns remain water pollution and insufficient water resources for its growing population. Deforestation and soil erosion still threaten Namibia's land. The percentage of protected land area remained constant between 1990 and 2005 (UNEP, 2008).

Fröhlich (2006) reports that environmental issues and risks in Namibia, have increased so much and so fast over the last century due to the greater pressure on resources, increased human population, unsustainable practices, human power relations and greed, people's ideas of progress, industrialization and independence from colonial powers. Thus, all the critical environmental issues in Namibia have a history in the local socio-ecological history and their history has been influenced by pre and post independence events. The following section will look at how Namibia is responding to her environmental issues and risks.

## **2.4 HOW NAMIBIA IS RESPONDING TO THE ENVIRONMENTAL ISSUES AND ASSOCIATED RISKS**

### **2.4.1 General responses**

Namibia is a signatory to international treaties on the environment. Examples of these are international conventions are such as the Convention for International Trade in Endangered Species (CITES); Sub-regional Action Programme to Combat Desertification in Southern Africa (SRAP); Convention of Biological Diversity (CBD); the International Framework Convention of Climate Change (IFCCC) followed by the Kyoto protocol; the Convention of Wetlands of International Importance (RAMSAR); the Vienna Convention on the Law of Treaties; SADC Policy and Strategy for Environmental and Sustainable Development among others (Fröhlich, 2006). These conventions and international treaties have shaped the introduction of environmental education in Namibia.

Lotz-Sisitka (2002) stated that since the 1992 Rio Earth Summit in Brazil, many African countries have signed a number of multi-lateral agreements, including Agenda 21 and numerous environmental conventions which influenced local policies and practices including education. In relation to this statement, Namibia was one of the countries that adopted Agenda 21 and since then have incorporated it in its National Constitution (Article 95). Out of article 95, the following were developed:

- The Green Plan to create national common vision for sustainable development,
- National Development Plan 1 (NDP 1) which incorporated sustainable development as a key focus,

- NDP 2 which made a clear link between sustainable development, economic development, social development and institutional development, and
- Vision 2030 which fully embraces the idea of sustainable development and aims to guide the country's 5 year development plans (Namibia. MoE, 2009).

Since 1992, most policies and programmes in Namibia have been influenced by these documents, and all government sectors are integrating the principle of sustainable development into policy and practice, including the education sector. The next session will thus look at how the formal education sector is being reoriented towards responding to Namibia's environmental crisis, and the need for sustainable development of the country.

#### **2.4.2 Education as a response to environmental issues and risks in Namibia**

UNEP (2006) argues that environmental issues are now pervasive and ingrained within our cultural ways of being. UNEP further states that we can no longer look at science alone to solve these problems. In many countries including Namibia, EL is incorporated in the curriculum. The Enviroteach project, Life Sciences project (1991-2000) and the SEEN project (established in 2001) have all specifically supported early environmental education development programmes funded by the Danish government as a key response to environmental issues in the Namibian curriculum (see below). These projects, similar to other international environmental education policies (explained in Section 2.2.1 above) all motivate for and explain that, EL is one of the most important factors in tackling environmental problems. As part of EL across the curriculum, learners are provided with necessary skills and knowledge that can help them to understand how to deal with environmental problems such as land degradation and pollution (Fröhlich, 2006). As indicated in Chapter 1, the research question relevant to this study was to investigate how selected Namibian Biology teachers handle environmental topics in the curriculum so that learners may gain the knowledge, awareness, values and skills to solve environmental problems.

As part of the response to Article 95 of the Namibian Constitution, similar to many other countries there were several debates and discussions on how environmental education should be dealt with in the curriculum; as a separate subject or integrated across the curriculum (Gough, 1997; Lotz-Sisitka, 2002). Most authors argue against the establishment of environmental education as a separate subject, because of epistemological reasons. As environmental concerns

cannot be isolated and confined to one single discipline they have an important contribution to make to the development of more holistic forms of EL (*ibid.*). This interdisciplinary character of environmental education, has led to environmental education being placed as an orientation in the curriculum within different disciplines and subjects due to practical and epistemological factors. Environmental issues are complex thus should be discussed across different disciplines (Enviroteach, 1995; SEEN, 2005).

Based on this epistemological logic, environmental education has been integrated as a cross-curricular theme within the broad curriculum and each subject has integrated aspects of environmental education. This approach to environmental education has been supported by the three major environmental education development projects in Namibia, including the Life Science Project, Enviroteach and Supporting Environmental Education in Namibia (SEEN).

#### **2.4.2.1 The Life Science Project**

The Life Science project ran in Namibia from 1991 to 2000 (9 years). The project has its roots in the struggle against apartheid in the 1970s and 1980s. It was introduced at the Namibia Secondary Technical School in Exile in Loudima, Congo in 1986 - 1990, with the idea of teaching learners in a practical and hands on way about food production in an African rural setting. After independence the Life Science project was implemented in the formal national Namibian school system (Kristensen & Andersen, 2001).

According to Van Harmelen (2000:2) the major components of the Life Science project were:

- Curriculum development and the production of learning materials. In this regard the project assisted the National Institute for Education Development. Members and conveners of various ministerial working groups and curriculum coordinating committees in the development and revision of syllabi. A new subject syllabus for Life Science was produced and revised over the project period. The Life Science project developed and distributed textbooks and other learning support materials.
- The supply of teaching equipment to schools/institutions. The project identified, purchased and distributed basic laboratory and field equipment to all upper primary and junior secondary schools, teacher training colleges and teacher resource centres.

- In-service and pre-service teacher education through in-service development either at national, regional or local workshops, cluster meetings or school visits. The in-service programme was designed to develop subject knowledge and teachers' pedagogical knowledge, through enhancing their methodological and didactic skills to enable them to adopt a learner-centred approach.

The Life Science project has supported learner-centred education (a core element of the 'Towards Education for All' policy) and was devoted to encouraging learners to solve their own problems, to promote critical thinking, practical work and self confidence. Central to learner-centred education is the assumption that knowledge is created by individuals through a process of making sense that involves establishing a link between prior knowledge and new information. The process happens both individually and socially by constructing, de-constructing and re-constructing knowledge (Kristensen & Andersen, 2001). Its example has inspired other subjects, thus becoming one of the front runners of the educational reform in Namibia supporting the goals of the Ministry of Education's policy document "Towards Education for All", the cornerstones of which are access, equity, quality and democracy (Bones, 1994).

The Life Science project supported Namibian education authorities in the areas of production of materials, revision of syllabus, teaching equipment and more importantly, maintaining the training of pre-service and in-service teachers (the project had trained 1, 800 teachers at junior secondary level by the end of its cycle). By the time the project was complete, Life Science was a fully developed subject and teachers were trained to teach it on an ongoing basis. Life Science as a subject is among the Natural science subjects. According to the Namibian Ministry of Education (2009), Natural Sciences (Biology, Life Science and Natural Science and Health Education) are offered in the following three phases:

- Life Science is partly introduced at Upper Primary level (Grades 5 to 7) as Natural Science and Health Education;
- At Junior Secondary Phase (Grades 8 to 10), although taught separately, Life Science is part of the Natural Scientific area of learning together with Physical Science and Agriculture; and
- At Senior Secondary Phase (Grades 11 and 12) Biology Syllabus.

The basic aims of the Biology, Life Science and Natural Science and Health Education syllabi is the same for all learners, whether or not they intend to go on to study Science beyond this level (see Section 2.5). Relevant to EL, the Natural Science subjects have common environmental topics integrated in them but learning objectives are at the different levels. The cross-curricular issues (see Section 1.1) serve as a direct link of the Natural Science syllabi to other subjects for the Namibian school curricular.

#### **2.4.2.2 The Enviroteach project**

The Enviroteach project (established in 1992 and completed in 1999) was an environmental education programme of the Desert Research Foundation of Namibia (DRFN). Also funded by the Danish government it was established to spearhead and strengthen a cross curricular approach to environmental education in Namibia as the Life Science project only worked at the level of one subject. According to Enviroteach (1998), when the Enviroteach project started, environmental education was not part of the curriculum, except for a few brief sections in certain carrier subjects, mostly Geography and Natural Sciences and it was only being developed within the Life Sciences subject at the time. DRFN explored options for effective incorporation of relevant environmental information into formal education. As a result, an agreement between DRFN and the Ministry of Education was signed, allowing for the introduction of the Enviroteach programme within the formal education programme. Enviroteach's main goal was to address the issues of environmental education through the education reform process. The project investigated ways in which environmental education could be best included in the formal curriculum. The implications of inclusion of environmental education in formal education as a distinct separate subject or infusion or integration of environmental education across the curriculum, were carefully studied at the time, and the project chose "the infusion and integration of environmental education across the curriculum" Enviroteach (1995:33), based on the epistemological argument discussed above.

The project promoted the importance of environmental education by equipping teachers and learners with skills and challenges involving sustainable living. This was done as an outreach programme through which environmental education was introduced as a cross-curricular theme. Environmental education was seen as not only contributing to an environmentally literate society, but also to the education reform process by promoting cross-curricular and learner-

centred approaches to teaching and learning (Enviroteach, 1998). The Enviroteach project implemented means and methods for integrating environmental education into the Namibian formal education system. The Enviroteach project also developed books that were Namibia-focused, are cross-curricular and focused on a wide variety of environmental issues. The books are written from a holistic viewpoint encompassing social, economic and political aspects of the environment. They are designed as resource manuals rather than textbooks, providing ideas for information, activities and projects for environmental education. Therefore, the Enviroteach projects had three major components; curriculum development and production of learning support materials, supply of teaching equipment to schools and institutions and in-service training and pre-service teachers' education. By the time the project ended environmental education was established as a cross curricular learner-centred concern in the Namibian curriculum, but further impetus was needed to train teachers and curriculum advisors on this new cross curriculum issue, and the SEEN project was established as a follow on project from the Life Sciences and the Enviroteach projects.

#### **2.4.2.3 Support Environmental Education issues in Namibia (SEEN) projects**

As noted by Janse van Rensburg and Le Roux (1998), Namibia is a country with few opportunities for education and training within the field of environmental education. It was also struggling to implement the ideals of education reform, which promotes 'Towards Education for All' through learner-centred education, based on principles of social constructivism. The area of environmental education is also relatively new on the Namibian education landscape, the result of which is few environmental education practitioners who are both confident to, and capable of, implementing environmental education along the lines of current education reform principles. In response, the SEEN project was established in 2001 to develop professional development courses in environmental education for adults in the non-formal and formal education sectors. This was to help build a foundation of critical, reflective and active environmental education practitioners. There was a need for the SEEN project to incorporate the professional development of the formal education sector practitioners as there was little capacity or time available to develop a separate course for this sector. As a result, a truly national environmental education course, the Namibian Environmental Education Certificate (NEEC) was born in 2001. This is the certificate course that I completed in December, 2010.

Janse van Rensburg and Le Roux (1998) added that as part of the outputs for the SEEN project, accreditation for the Namibian environmental education certificate was acknowledged as a priority. Among other reasons, the Namibian environmental education certificate was accredited for employment opportunities within the environmental education field, for further education opportunities, to raise the profile of environmental education within organizations, for study opportunities amongst the marginalized and to promote environmental education. Areseb (personal communication, 2011) noted that issues related to the environment, such as global warming, greenhouse effect, environmental degradation and impacts of floods on human life as well as problems of feeding the world's population, were extensively addressed across the curriculum through SEEN. SEEN (2005) identifies six broad EL themes to be addressed across curricula; natural resources and their management, poverty and inequality, society and governance, development and the environment, health and the environment and globalisation. SEEN indicated that Biology should address the learning theme on natural resources and health and the environment.

According to SEEN (2005), the aims and objectives of EL in the Namibian curriculum are to:

- Encourage and promote in learners a holistic understanding of the dynamic interdependence of all living things and their environment;
- Promote a sense of responsibility toward restoring and maintaining ecological balances through the sustainable management of natural resources; and
- Encourage an involvement in practical activities to preserve and sustain the natural environment through ... a learner-centred methodology that promotes learning through understanding ... and introduces practices that reflect and reinforce both the values and practices of democracy.

The SEEN project supported the cross curricular approach to EL in the Namibian curriculum and developed a number of curriculum guidelines documents to show how the environmental focus and topics could be addressed in the various subjects. For example, Home ecology and Life Skills deal with issues that inform us about how people live together (social), Science and Agriculture deal with living things and life support systems (biophysical), Business Studies,

Economics, Geography deal with jobs and money issues (economic) and Social and Development Studies deal with issues of power, policy and decisions (political). SEEN also dealt with pedagogical issues and for example, provided guidelines on issues based approaches to EL (SEEN, 2005).

The project supported the assumption that solving environmental problems depends to some extent on if and how EL is implemented in schools and Bones's (1994:15) view is that "Today's students are tomorrow's leaders and decision makers; they need to learn and practice the skills necessary to protect, preserve and restore the environment". It is also supported by UNESCO's (1997) view who note that:

It is widely agreed that education is the most effective means that society possesses for confronting the challenges of the future. Indeed, education will shape the world of tomorrow. Progress increasingly depends upon the products of educated minds: upon research, invention, innovation and adaptation. Of course, educated minds and instincts are needed not only in laboratories and research institutes, but in every walk of life. Indeed access to education is the *sine qua non* for effective participation in the life of the modern world at all levels. Education, to be certain, is not the whole answer to every problem. But education, in all broadest sense, must be a vital part of all efforts to imagine and create new relations among people and foster greater respect for the needs of the environment (paragraph 38).

The SEEN project also raised awareness of the need for Namibians to engage with the UN decade of ESD, a process which has been taken forward into the development of an ESD strategy for Namibia, which is still ongoing. The UNDESD supports the role of environmental education and ESD in contributing to educational relevance and quality, which are issues of concern for the EL focus in the Biology curriculum which I turn to next.

Having looked at the broader perspective of how education responds to environmental problems in Namibia, as mentioned in Chapter 1, this study will specifically focus on formal education and Biology curriculum for two reasons. Firstly, there is a perception that Biology is one of the subjects that broadly covers environmental topics, and secondly as indicated in Chapter 1, Biology is my major subject of specialization. Therefore, the following section looks at how the Biology curriculum responds to Namibia's environmental challenges.

## 2.5 ENVIRONMENTAL LEARNING WITHIN NSSC BIOLOGY CURRICULUM

In the light of constitutional obligations, all syllabi including Biology should address environmental issues. According to the Namibian Ministry of Education (2008), among many other aims, the Biology syllabus enables learners to:

- Develop an understanding of biological and ecological principles and interactions in the environment, and encourage them to use the environment in a sustainable way;
- Develop an understanding of the basic functions of the human body, be aware of diseases and the importance of a clean environment in order to maintain a healthy lifestyle;
- To develop a responsible attitude with regard to family planning and sexuality, importance of decision making and impact of HIV/AIDS on one's health;
- To acquire sufficient understanding and knowledge to become confident students in a technological world;
- Develop an awareness that the study of Science is subject to health, social, economic, technological, ethical and cultural influences and limitations, understand that Science has and that the application of Science may be both beneficial and detrimental to the individual, the community and the health of the environment; and
- To acquire understanding of knowledge in Natural Sciences through a learner-centred approach and stimulate interest in and care for the environment.

SEEN (2005) stated that the Biology syllabus aims at increasing the learners' knowledge and understanding of the physical and biological world. This includes understanding how people use the natural environment to satisfy human needs. The application of scientific knowledge and attitudes, in the framework of sustainable use of resources, is of relevance for the individual, the family and the society as a whole. Process and manipulative skills are essential to understand the value and limitations of natural scientific knowledge and methods, and their application to daily life. In order to meet the above aims, environmental topics have been integrated within the Biology curriculum. This responds to the policy documents that aim at producing an ecologically and environmentally literate society (see Section 1.1). The SEEN aims have thus been integrated in the Biology syllabus aims to enable learners acquire and develop competencies in EL (see

Section 2.5). These aims are meant to be achieved through certain syllabus learning objectives (see Section 4.2.1.1), and thus can be achieved through effective implementation of EL.

The current Biology syllabus adheres to international standards linked to accreditation and certification and tends to focus more on universal Science knowledge, especially at higher grades (Areseb, personal communication, 2011). As a result it does not influence the way we think about the environment locally. According to a contextual profile done in preparation for this study, most of the conventions and knowledge related to the local environment is accommodated in the Junior Secondary syllabuses, which is not efficient knowledge for learners (Tshiningayamwe, 2011). The Biology syllabus can be changed or improved by responding to more local issues than global issues, by strengthening participation into practice, which might result in fully promoting socio-ecological resilience. Hogan (2008) indicated that educational approaches must look into strengthening situated learning while promoting capabilities. Stevenson (1997) argues that environmental thoughts and environmental ethics are dynamic thus our practices must also be dynamic, hence the recommendation from the Ahmabadad declaration of 2007 for paradigm shift in our practises and the need for transformation in environmental education. Much has been learned in environmental education theory and practice in southern Africa over the past 20 years (Lotz-Sisitka, 2004), which provides insight into this dynamism, which may be of value in considering EL and the SEEN (2005) recommendations for EL in the Biology curriculum. I discuss this next.

## **2.6 ENVIRONMENTAL EDUCATION AND ENVIRONMENTAL LEARNING IN THE SOUTHERN AFRICA CONTEXT AND ELSEWHERE**

Environmental and sustainability issues in southern Africa are complex and contested. Part of the complexity lies in the historical foundations of contemporary development patterns and contemporary patterns of socio-economic policy and practice. Fröhlich (2006) and Lotz-Sisitka, Olvitt, Gumede and Pesanayi (2006) note that southern Africa's environmental problems (socio-ecological issues) include widespread poverty, unemployment, soil erosion, biodiversity loss, littering, urbanization, health hazards, environmental degradation, pollution, global climate change, ozone depletion, diseases (HIV/AIDS, tuberculosis, malaria) and water scarcity. Some of these are reflected in the Namibian context (as discussed in Section 2.3 above). The varied nature of the crisis means that everyone is affected in some way although some may suffer the impacts more directly than others.

Due to the above, Lotz-Sisitka (2004) and Kethoilewe (2010) indicate that most of the southern African countries are engaged in a variety of initiatives to infuse environmental issues into the mainstream curriculum. Environmental and sustainability issues are cross-cutting and require multi-disciplinary responses into the mainstream curriculum. This, however, according to UNEP (2006), remains a challenge. Kethoilewe (2010), writing from Botswana, notes that to implement environmental education, teachers do not only require curriculum policy changes, strategies and plans, they also need a deeper understanding of what is required and what and how to implement in particular contexts. He added that, the major challenge of environmental education is to meet the training needs of educators with the view to effect profound changes in their ways of thinking, attitudes and behaviours for sustainable development.

The Nelson Mandela Foundation in South Africa (established under the South African discriminatory apartheid policies) (2005) and Rosenberg (2008) also writing from South Africa report that most schools in South Africa are in the former homelands, with inadequate resources. Most teachers in these contexts were trained under Bantu education and communities in these areas are affected by poverty and socio-ecological stresses. Complex histories have not developed adequate abilities or appropriate conditions to enable epistemological access. Rosenberg (2008) further notes that education policies are focused at readdressing past inequalities, on the relevance of curriculum content and on active participation in community life. But implementation is falling short. Capacity to interpret policies and to effectively provide resources, staff and systems for implementation, hamper many government departments including schools education. Some schools are characterized by a lack of discipline and strife among the staff, low motivation and morale, poor management and poor leadership from the principal. Rosenberg further notes that research into the most effective strategies of improving the quality of education would be through interventions such as textbooks supply, better curriculum planning and leadership, better time management on the part of the teacher and high quality teacher training. Such issues are relevant more widely in southern Africa, as most countries are responding to inadequate education provision and quality related issues following colonial rule (Lotz-Sisitka, 2004).

According to Loubser (1997); Kethoilewe (2003); Kethoilewe (2007) and Hogan (2008), some of the factors that constrain educators in implementing EL in southern African schools are; a perceived lack of teacher preparation, lack of funds, teachers unwillingness/inability to

implement EL in their pedagogical practices, the poor relationships between school and community, lack of educational resources, an overcrowded curriculum, and teachers' resistance to change. Ketlhoilwe (2003) added other constraints for effective EL to be skills or knowledge available at school, EL concepts are difficult to interpret in syllabi and textbook, large class sizes, lack of external support e.g. from local education authorities, attitudes of some school heads, colleagues and parents and lack of adequate in-service teacher training. Ketlhoilwe also argued that in most cases EL is treated as an additional burden and teachers are not willing to take it up. Malcolm (undated: 20) argues that "environmental education development and implementation is seriously hindered by an emphasis on separate subject areas, conventional timetables, 'textbooks' learning, traditional assessment methods".

Similar to Chi-chung Ko and Chi-kin Lee's (2003) study in Hong Kong, Ketlhoilwe (2003) indicates that fieldwork is seldom done due to transport and time constraints. They highlighted that the school environment is not conducive for implementing EL; the existing curriculum is too theoretical and not suitable for the infusion of EL. Safety problems were perceived to be a barrier to the provision of field experience, "you can't teach environmental education without being outdoors" (Chi-chung Ko & Chi-kin Lee, 2003:6). Ketlhoilwe (2003) added that, for a conducive learning environment to be created there should be more opportunities for fieldwork and projects to supplement theoretical classroom activities.

Peden (2008) observes that teachers are not prepared well enough to integrate environmental education in their classrooms. Teacher training programmes have limited access to environmental education content and methods. Thus, many explanations that focus on EL see teachers as lacking the expertise to actively engage learners in environmental issues. This is not only a southern African issue, however, as Ham and Sewing (1988) who report from North American, that teachers have serious misconceptions about the nature and scope of environmental education; they see it as mostly appropriate to the Science curriculum; they have misgivings about their competence to conduct environmental education programmes; and they show perceived lack of logistical support in terms of resources, time and suitable class sizes. But, Shuman and Ham (1997) state that despite the barriers to teaching EL, some teachers pull through towards teaching EL because of their positive attitudes toward environmental education and their feeling of responsibility *for* the environment. Rosenberg (2008) reports similarly on the significance of motivation and commitment of some teachers in EL programmes. Rosenberg

reports other enabling factors for EL in South Africa as reduced numbers of learner teacher ratio in most schools, better school-community relationships, pedagogical renewal, and support by some government department and non-governmental organisations encouraging and environmental policies endorse environmental education in schools. Rosenberg also notes that, the Eco-schools programme initiative launched in 2003 by Wildlife and Environmental Society of South Africa (WESSA), improves the quality and relevance of education by: improving learner motivation, whole school management and planning, provision of resources to support teaching and learning, improved teacher competence, curriculum management and delivery.

Hogan (2008) observes that learners in mainstream schooling are overburdened with 'isolated and meaningless facts', schools do not provide settings for social interactions conducive to knowledge constructions. Peden (2008) and Stevenson (1997) suggest that it is not helpful to add new facts or themes but to rather renew educational concepts and approaches by strengthening the meaning and substance given to environmental content in education. Environmental education should also develop critical thinking that induces a change of attitudes and behaviours among students. Peden (2008) added that topics that currently exist in the curriculum are not addressed in a coherent, structured and critical manner. An explicit environmental focus could be a starting point for powerful, integrated knowledge where both teachers and learners deepen their understanding on the topic and the subject. She proposes attempts to build disciplinary knowledge by introducing core environmental literacy courses early on in teachers' education programmes, so that environmental knowledge informs the pedagogy of teachers.

Ketlhoilwe (2003) notes that most teachers felt the necessity of EL in schools, because as population increases the environmental problems increase, hence, learners need to be sensitized and educated to respond to these issues. But he reports that little environmental education is taking place in most schools. There is a lack of understanding as to how environmental education implementation should proceed, lack of commitment among some education authorities and as a result environmental education is afforded a low status compared to other issues because EL is not examined or timetabled and teachers concentrate on examinable subjects. In later research Ketlhoilwe (2007) reported that teachers tended to normalise new environmental knowledge into old forms of practice. For example, they saw all environmental education as environmental science, and tended to emphasise school ground cleaning as a main environmental education

activity, reducing the possibilities for holistic development of environmental education concepts, knowledge, skills and values. He recommends stronger forms of teachers' professional development. These findings from regional research resonate with Fien's (1993) earlier research and later research by Cotton (2006) who reveals that development of critical thinking and problem solving among learners is failing because of lack of adequate support from education authorities. Since all the enabling and constraining factors given above could be applicable in the Namibian situation, there is a need to develop further an in-depth understanding of how these can be maximised (the enabling factors) and minimised (the constraints) including through improved pedagogical practices, which I turn to next. The following section looks at environmental education pedagogies that can develop learners, skills, knowledge, values, and attitudes, as this is identified as important for integrating EL into subject curricular (SEEN, 2005).

## **2.7 PEDAGOGIC APPROACHES TO ENVIRONMENTAL EDUCATION**

Environmental issues are complex and they are changing all the time, therefore there is a need for methodological shifts in implementing environmental education. Ketlhoilwe (2010) indicates that in southern Africa, the implementation of environmental education demands a review of current epistemological and pedagogical practices. He added that there is a need to interrogate the possible epistemological and pedagogical practices for promoting environmental education in southern Africa.

According to Kostova and Atasoy (2008), successful EL depends on the teaching and learning methods used. They noted that it is no longer enough for the teacher to know a lot, or to be able to explain it in a simple and interesting way. The teacher should be able to facilitate EL by stimulating learners to ask questions, reacting to their answers, helping them accept challenges and disagreements, discuss contradictions, think critically and offer creative solutions. Jensen and Schnack (2006) argue further that teachers should help learners to develop action competence, a point which Silo (2009) agrees with. She emphasises teachers' responsibility for strengthening learners' participation in developing action competence in response to issues in Botswana. Silo (2009) stated that in Botswana, participation in EL activities has been perceived as a central component of environmental education in formal education. Her study revealed that attempts by teachers to engage learners in EL have been done, the assumption appears to be that this will transform pedagogy and consequently, change the pupils' into competent participants in

environmental education. But her findings further revealed that efforts to engage learners develop tensions and contradictions between participants for developing competent learners through their participation. This gave rise to an elusive object of learner participation, as the purpose for their participation in these activities is not clear.

Ketlhoilwe (2003) supports the use of learner-centred, participatory and active learning methodologies when facilitating EL in formal education. He, like Kostova and Atasoy (2008) argue that, a combination of teaching and learning methods oriented towards agency, capabilities, social and structural changes are likely to achieve EL objectives. Examples of these methods are; role play, active learning, investigation/experiential learning, group work, presentations, discussions, debates, field work, homework studies, demonstrations, observations and collaboration. Loubser (2008) emphasised that, effective EL has to move away from teaching and learning approaches based solely on the transmission of knowledge. It has to move towards approaches which encourage development of qualities, such as initiative, reflection and responsibility in relation to the environment. It has to foster values and attitudes which influence behaviour and action. Thus he also supports learner-centred approaches for stimulating and maintaining learners' interest in the environment. This is also supported by Lotz-Sisitka et al. (2006) who report on ESD practices and note that learner-centred, active approaches to learning are strongly supported in southern Africa environmental education/ESD. Thus, as suggested by Lee (1997), educators can, and should, find ways to present environmental concepts that will allow learners to draw their own conclusions about important environmental and societal issues. Successful EL in the Biology curriculum will therefore depend on teachers chosen methods for teaching and learning.

Hogan (2008) also supports the use of learner-centred approaches. She highlights the use of everyday contexts and experience for meaningful learning. She argues that using everyday contexts involve learners in classroom activities that increase learners' confidence in solving local issues. This allows learners to share responsibilities and to take control of their own learning. Hogan believes that, for EL to develop learners' environmental competencies, it should promote transformative pedagogies that empower learners to link socio-ecological issues and development in local contexts. For example, in the Namibian context, EL should transpire

through teaching concepts like conservation and management, which has a broader scope of interpretation and could be tailor-made for the particular setting, e.g. the Erongo region would look at the issues of the lagoons and how the communities could use them sustainably in more depth. Elsewhere, the Northern regions could tailor-make curricular to address the sustainability of the 'Oshanas' and the perennial rivers as well as land clearance practices. This mobilises both individual learner's prior knowledge and experience, and the prior knowledge and experience of people in the community. UNEP (2006) seems to support this by noting that the study of issues and concerns related to the environment should engage learners and should be relevant to their communities. With EL, learners are viewed as constructors of their own knowledge rather than reproducers of others' knowledge. Learners should thus, take a more active role in their own learning, and become co-learners and co-investigators with their teachers in a collaborative learning process. This is also supported by the Enviroteach and SEEN projects that emphasise enquiry based teaching approaches and action competence development.

Hogan (2008) found that integrating local environmental cultural knowledge successfully contributes to curriculum relevance both epistemologically and pedagogically. It also fosters stronger school-community relationships. It involves teachers and communities in ethical deliberations about environmental concerns. From this it is possible to surmise that EL will be successful if Biology teachers consider the context, learners' participation and involvement when planning and teaching environmental topics. But similar to Janse Van Rensburg and Lotz-Sisitka (2000) and Peden (2008), Rosenberg (2008) indicated that learner-centred approaches to education are being interpreted in problematic ways, resulting in 'empty' superficial or incoherent learner activities with little content. She added that teachers trained in the Bantu Education system have not been prepared to integrate everyday knowledge with schools or formal knowledge. Many teachers find it difficult to use available content-rich resource materials effectively to plan and support lessons.

Monroe and Kaplan (1988) writing in the USA context, claim that involving learners in action projects can help learners become environmental problem solvers. Action projects offer an opportunity to practice resolving local issues with teacher and peer support. They argue that learners would become empowered in a sense of success and develop action-taking skills. This

resonates with the views of Posch (1993:11) who wrote that “an important condition to develop values which are environmentally sound is to involve students in actions in which they are able to leave traces and in which they feel that what they do can make a difference”. Lee (1997) also observes that learning by *doing* is recommended. Learners acquire knowledge, skills and attitudes through practical and applied activities. He further observed that, for successful EL students should satisfy their curiosity, they should be open-minded and be actively involved in the learning process. However, Monroe and Kaplan (1988) observed that action projects are often not carried out in schools; they entail a variety of constraints including the inability to leave school, short class periods, lack of learners’ knowledge and skills and lack of materials to guide the process. As indicated by Ketlhoilwe (2007) and Silo (2009), teachers’ normalisation practices also constrain EL and can reduce action learning possibilities if learners’ participation is not given due attention. Cotton (2006) highlighted that action projects provide knowledge, skills, awareness and action to learners. They also develop ownership and pride in their schools; a point also made by Rosenberg (2008) when she states that through linking environmental projects with curriculum learning provides teachers with opportunities to bridge between everyday knowledge and experiences of learners and the formal knowledge required by the curriculum.

Shulman (2004:100) assumes that “most teaching is initiated by some form of “text”: a textbook, a syllabus, or an actual piece of material ...”. This assumption is confirmed by Chi-chung Ko and Chi-kin Lee’s (2003) research findings that indicated that, in Hong Kong many teachers continued to use exposition methods and rely on textbooks and the syllabus when they are teaching environmental topics. The teachers’ main concern is fear of “not covering the syllabus” (p.200). They also found that teachers find the syllabus and the textbook to be overburdened with information that makes it difficult to find time for innovative methods. Also looking at the same context, Stimpson (1997) observes that, on average teachers’ teaching styles were more teacher centred and teachers put more emphasis on teaching environmental knowledge, less on attitudes and least on skills. He further found that lectures and experiments are the most popular teaching methods, some teachers occasionally use other methods such as informal discussions and group projects, computer-assisted learning activities, field trips, outdoor activities and role play were teaching methods that teachers have not used because of constraints but would like to use.

Fien (1993) and Loubser (2008) drawing on Fien (1993) stated that, the range of teaching approaches and strategies used should provide opportunities for learning *about, in/through* and *for* the environment. Lee (1997) states that education *in/through, about, and for* the environment provides learners with opportunities to learn about the functioning of natural systems, to identify their beliefs and opinions, consider a range of views, and ultimately make informed and responsible choices for themselves, their families and their communities. The following section explains the education *in/through, about* and *for* the environment.

### **2.7.1 Education *in/through* the environment**

Education *in/through* the environment involves the use of real-life situations as a basis for inquiry teaching (Lee, 1997). This type of education uses learners' experiences in the environment as a medium of learning. Teaching methods related to this learner-centred approach include solitaire, encounter, dialogue, discussion and reflection. This approach should, according to Thomas (2005), supplement learners' knowledge and facts about the environment through direct contact with it.

### **2.7.2 Education *about* the environment**

Education *about* the environment refers to the environment as a subject for investigation; it includes the provision of information on environmental issues and the teaching of appropriate technical and intellectual skills (Lee, 1997). This type of education emphasizes knowledge about natural ecosystems and processes and the ecological, economic and political factors that influence decisions about how people use the environment. Fien (1993:15) sees this education "as solely based on building learner's cognitive ability without any action taken to promote sustainable living". Lee (1997) notes that, methods associated with this approach are most often 'show' and 'tell'. This approach can be effective if learners are provided with opportunities to do projects that allow them to find information about the environmental issues. Learners can then analyse the information, compare, predict and draw conclusions based on the knowledge they have acquired.

### **2.7.3 Education *for* the environment**

Education *for* the environment pursues deliberations and the practicing of appropriate environmental attitudes, ethics and behaviours, as well as the skills needed to generate a quality environment (Fien, 1993; Thomas, 2005). Therefore, education *for* the environment is

considered most appropriate to the global crisis. It is aimed at encouraging participants to think critically and develop a critical environmental consciousness. This is vitally needed in Namibia with its serious depletion of natural resources (SEEN, 2005), hence inquiry-based and action competence development approaches were promoted by both the Enviroteach and the SEEN projects. Learners should be actively involved in decision making and problem solving. Education *for* the environment, in essence, “promotes well-being as its goal” (Robbottom, as cited in Fien, 1993:15).

Fien (1993) argues that EL problems arise from the difficulties many teachers seem to have in matching the rhetoric of the critical pedagogical practices of education *for* the environment with the problems and the realities of teaching and learning. In addition, he stated that many teachers are concerned about the pressure from colleagues, school administrators, parents and community groups and politicians if they encourage students to become interested in controversial issues. As a result, many teachers fall back upon the ‘safer’ approaches of education *about* and *through* the environment, abandoning education *for* the environment. This may hinder the success of EL. The focus on education *for* has also been taken up in the UNED (UNESCO, 2005) where it is argued that education should be *for* sustainable development and should be based on the same kinds of critical and action oriented pedagogical principles promoted by Fien in the early 1990s. Development of teachers’ capacity for implementing such pedagogical processes has been a recurring theme in the EL literature (Fien, 1993; Van Harmelen, 2000; Kethoilwe, 2003; SEEN, 2005; Frohlich, 2006; Stevenson, 2006). As has been the issue of the structural aspects of formal schooling systems that make it difficult for teachers to integrate and implement those approaches Stevenson (2006): issues which I outline in more detail in the Namibian curriculum context below.

## **2.8 ENVIRONMENTAL EDUCATION AND ENVIRONMENTAL LEARNING WITHIN THE NAMIBIAN CURRICULUM**

### **2.8.1 Pedagogical approaches for EL in Namibia**

In Namibia, teaching methods have shifted from early positivist approaches, where environmental education was about transferring information and raising awareness towards participatory methods based on social constructivism, influenced by Life Sciences projects, Enviroteach and SEEN projects and the learner-centred education policy in Namibia. New

methods are now emerging which are ontologically situated, for example the inquiry-based methods promoted by SEEN (SEEN, 2005).

In the Namibian context, curriculum builds on learner-centred education in accordance with the 'Towards Education for All' policy (Namibia. MEC, 1993). Learner-centred education is a Namibian conceptual policy framework, which encourages learner participation and involvement in pedagogy. With regard to EL, learner-centred education will promote critical thinking and problem solving skills in learners. Learner-centred education sees a learner as an active, inquisitive human being, eager to learn, to investigate and make sense of his/her surrounding world. The learner brings knowledge from home, the community and environment to school, which should be utilized and drawn into teaching and learning. Learner-centred education takes into account that learners are individuals with their own needs. The Namibian Ministry of Education (2009) thus emphasises that in the classroom, attention should be given to individual differences through differentiation of teaching methods and teaching materials. Kanyimba (2002) highlights that this is often a challenge for most teachers, as in the implementation of EL it promotes progressive constructivist pedagogy, integration of disciplines and use of everyday knowledge related to disciplinary knowledge and structure.

Mubita (1998) highlighted that learner-centred education focuses on the learner and not the teacher. This has implications on the role of the teacher and the teaching approach in terms of teaching and learning, for instructional materials, and the way teaching is organised. A teacher in learner-centred education guides the learners in acquiring new knowledge and skills. This does not mean that the teacher is the source of knowledge, but rather that she/he facilitates the learning processes of the learners. The learners are to be empowered to think and take responsibility not only for their own but also for other people's learning and development. The classrooms should stimulate learning; allow aspects of problem solving and cooperative learning.

Learner-centred education techniques are based on involving the learners in the learning process. This is done by using different teaching techniques such as group work, project work, eliciting prior knowledge, drama and role-plays (Namibia. MoE. 2009). Learner-centred education allows learners to use their own knowledge to construct meaning and the teacher has the role of a facilitator in the learning process. This provides opportunities for addressing other goals of

education such as democracy, when using the learner-centred approach to teaching. It is said that with a clear understanding of the why and how learner-centred education is to be implemented many of the education goals would be achieved using different techniques.

However, Mubita (1998) explains that the teacher, the learners, the curriculum and the community should be considered in learner-centred education. He added that this will bridge the gap between society and school. This will help both parents, schools, teachers, learners and curricula unit planners to become one society or community with one goal in educational development. He added that it takes more than one person to educate a child towards becoming a better citizen.

According to Dahlstrom (1995) a learner-centred curriculum is a holistic and integrated curriculum. He added that integrated and holistic refers to the notion of connectedness in the sense that the learner will be able to make connections of what he or she learns. Thus, home and school curriculum should be interrelated in order to make sense for the learners. Therefore in designing the curriculum, the learner must be considered first and should be placed in the centre of the design. The experiences of the learner, both in school and outside school, should be taken into consideration.

Hoabes (2004) conducted research into how teachers were implementing learner-centred education and EL aspects in Life Sciences of Namibia. She found that lack of resources and big class size impede the fostering of EL in a learner-centred way, she also found that teachers were mainly interpreting learner-centred education in terms of changes in methods only. Some teachers appear to have little understanding of their own practices as being learner-centred. Teachers are not in agreement whether learner-centred education works. She recommended that continued support should be provided to teachers in the form of in-service training to help teachers understand learner-centred education better and to understand how the methods they use reflect learner-centred education (*ibid.*).

A number of other studies have also pointed to distortions and misunderstanding by teachers around learner-centred education. For example, Kanyimba (2002) indicated that learner-centred

education and related pedagogical approaches which are currently offered in Namibia are currently being challenged for not meeting the educational goals of social justice and denying learners access to powerful knowledge systems. Haingura (2009) seems to agree with him by recommending that there is a need to strengthen teachers' knowledge of learner-centred education and how to plan and implement it in Namibia. The next section will look at the challenges and successes for EL in Namibia.

### **2.8.2 Challenges and successes of environmental education and environmental learning in Namibia**

As indicated in Section 2.4.2, environmental education as an approach to education has been incorporated in all the subjects of the school curriculum. As mentioned earlier in Chapter 1, in Namibia, there are ministerial policy documents that support the incorporation of environmental education within the curriculum. Yet, environmental education continues to suffer from constraints that hinder its effective incorporation into the curriculum. Environmental education aims at preparing individuals to be responsive to a rapidly changing technological world, to understand contemporary world problems and to provide the skills needed to play an effective role in the improvement and maintenance of the environment (Kanyimba, 2002).

According to Enviroteach (1998), in Namibia environmental education opportunities in the curriculum increased after independence but not much progress has been made as there are/were a lot of constraints relating to implementation of environmental education such as lack of appropriate resources and lack of knowledge. In contextual profiling, I found that environmental education services are developing learning support materials to support learning process in schools but these are not distributed widely in schools (Tshiningayamwe, 2011).

The Namibian Ministry of Environment and Tourism (2006) state that, the major challenges of meeting the EL goals are to translate these goals into realistic ones. The goals of EL are to develop and adopt a set of interventions which will eliminate environmental problems. This can be achieved by establishing sustainable systems and producing knowledgeable, competent and innovative graduates that will solve environmental problems. The Ministry of Environment and

Tourism (2006) state further that, among many, some of the challenges of EL are the provision of human resources and ensuring that the policies in place are implemented by all stakeholders.

Areseb (personal communication, 2011) said that effective implementation of the policies and curriculum involves financial implications and training of human resources to coordinate and regulate the implementation process. The vastness of Namibia as a country poses a problem. This affects the review of the curriculum negatively. This not only affects curriculum policy implementation. Many policies and laws have been created to restrict certain human activities that cause environmental issues but as Enviroteach (1995) states, they are not adequately reinforced, thus some people's attitudes and behaviour towards the environment are still negative. Because of the ineffectiveness of some of the practices, tensions arise among individuals and organizations, even among curriculum developers.

Ugwanga's (1998) research found that, despite the good endeavour by the Namibian Government to provide distinctive education, there are many factors that hamper the delivery of a most wanted quality education. These factors include poor physical facilities, higher learner-teacher ratios, inequalities in resource allocation in educational regions and lack of qualified teachers, schools lacking basic education facilities such as textbooks, stationary, inadequate lesson preparations by the teacher, poor school management and administration and demoralised principals. In line with some of this are highlighted problems experienced during the implementation phase of the Enviroteach project, among them are:

- The resistance to change on the part of the teachers, school management, learners and parents;
- Lack of confidence and experience on the part of the teacher;
- Lack of support from school management who in many instance do not understand new methodology being promulgated through educational reform; and
- Lack of relevant, appropriate and user-friendly resources (Enviroteach, 1998:16).

Kasanda, Lubben, Gaoseb, Kandjeo-Marenga, Kapenda and Campbell (2005) clearly indicate that in Namibia, the 'empowerment' interpretation of learner-centred education (where learners

determine the direction of the learning experience), is not implemented. Therefore, a large number of learners have a poor match between their everyday world and their school world. Kasanda et al. (2005) further indicated that there is little evidence of group work and project work that would support learner-centred education. Kanyimba (2002) found that there is a need for teacher education and training in environmental education, appointment of environmental education coordinators in schools, environmental education policies for schools, interdisciplinary collaboration, fieldwork as an instructional technique and strengthened capacity of NEEN. These were recommended to increase the success of EL in Namibian schools.

Another study carried out in Namibia by Haingura (2009) on enhancing learner-centred education through the Eco-schools framework, found that integrating Eco-schools framework across the curriculum provides opportunities to enhance learner-centred education, to strengthen school-community interactions, enabling active involvement of learners in decision making. Haingura further found that the Eco-school initiative enhances learner-centred education in relation to diverse needs, and allowed for learner initiated contributions. In his study, he thus calls for more support from the principal and Ministry of Education for the success of integrating the Eco-school framework.

It is clear that there is much more enabling education reform in Namibia including an environmental focus in Biology (Namibia. MoE, 2009). Hoabes (2004) notes that most teachers are qualified to teach the subjects they teach. The teachers do receive support through workshops that acquaint them with subject content and methodology both at national, regional and cluster level, but the support is sporadic or insufficient for EL implementation. Hoabes thus recommended that teachers still need support to implement EL focus by for example, using learners in planning lessons, using visual aids and materials in ways that involve learners, using local environment when teaching environmental topics to contextualise this within learners' prior knowledge and experience.

To provide further depth of insight into implementation of EL in the context of pedagogical processes, knowledge and learner-centred policies, I drew on the theory of Pedagogical Content Knowledge (PCK) as this provides an integrating lens for understanding the research question. I discuss this theory in more depth in the next section.

## 2.9 THEORETICAL FRAMEWORK

As stated in the introduction, and as noted above the Pedagogical Content Knowledge (PCK) theory framework has been used in this study. This framework helped me gain partial insight on how the Biology teachers implement environmental topics as well as the enabling and constraining factors that influence such implementation.

Shalem and Pendlebury (2010) note that PCK is an overlap between subject knowledge and pedagogic knowledge, as indicated by Shulman (2004) in the figure below:

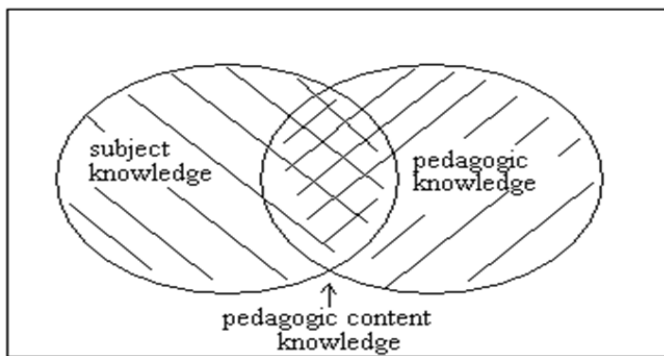


Figure 2.1: Overlap between pedagogic knowledge and content knowledge

An expert teacher must demonstrate knowledge of the subject being taught and knowledge of pedagogy. PCK emphasises that teachers construct their pedagogy through thinking how best to represent content knowledge to their learners. Van Driel, Verhoop and De Vos (1998:690) state that PCK in Science is:

The most regular taught topics in one subject area, the most useful forms of representations for those ideas, the most powerful analogies, illustrations, examples, explanations and demonstrations, in a word, the ways of representing and formulating the subject that makes it comprehensible to others.

Shulman (2004) created a model of pedagogical reasoning and action which comprises a cycle of several activities that a teacher should complete for good teaching: comprehension, transformation, instruction, evaluation, reflection and new comprehension. These are shown in Figure 2.2 by Wilson, Shulman and Richert (1987).

Wilson, et al. (1987) explored the model of pedagogical reasoning and action in a longitudinal research study of pre-service teachers making the transition into the classroom. They reported that a linear relationship existed among these components of pedagogical reasoning and action. Pedagogical reasoning begins with the comprehension of subject matter and continues with new comprehension after reflection on instruction. At the centre of this self-perpetuating process was the transformation of knowledge. They argue that the transforming of knowledge contains five subprocesses: preparation, representation, selection, adaptation, and tailoring (Wilson, et al., 1987).

- *Preparation* involves the examination and critical interpretation of knowledge of subject matter. In this first step, teachers winnow and reconceptualize their subject matter knowledge for pedagogical consideration.
- *Representation* entails the repackaging of subject matter in a manner suitable for instruction. These repackaged ideas included analogies, metaphors, stories, or any number of other representations.
- *Selection* comprises the choosing of appropriate educational strategies. These strategies accommodated some characteristic that will facilitate specific subject matter content.
- *Adaptation* includes the alteration of subject matter to fit the characteristics of specific students. Considerations of students' prior knowledge and the pedagogical objectives for the lesson influence adaptation.
- *Tailoring* results in a special configuration of subject matter for students with individual needs.

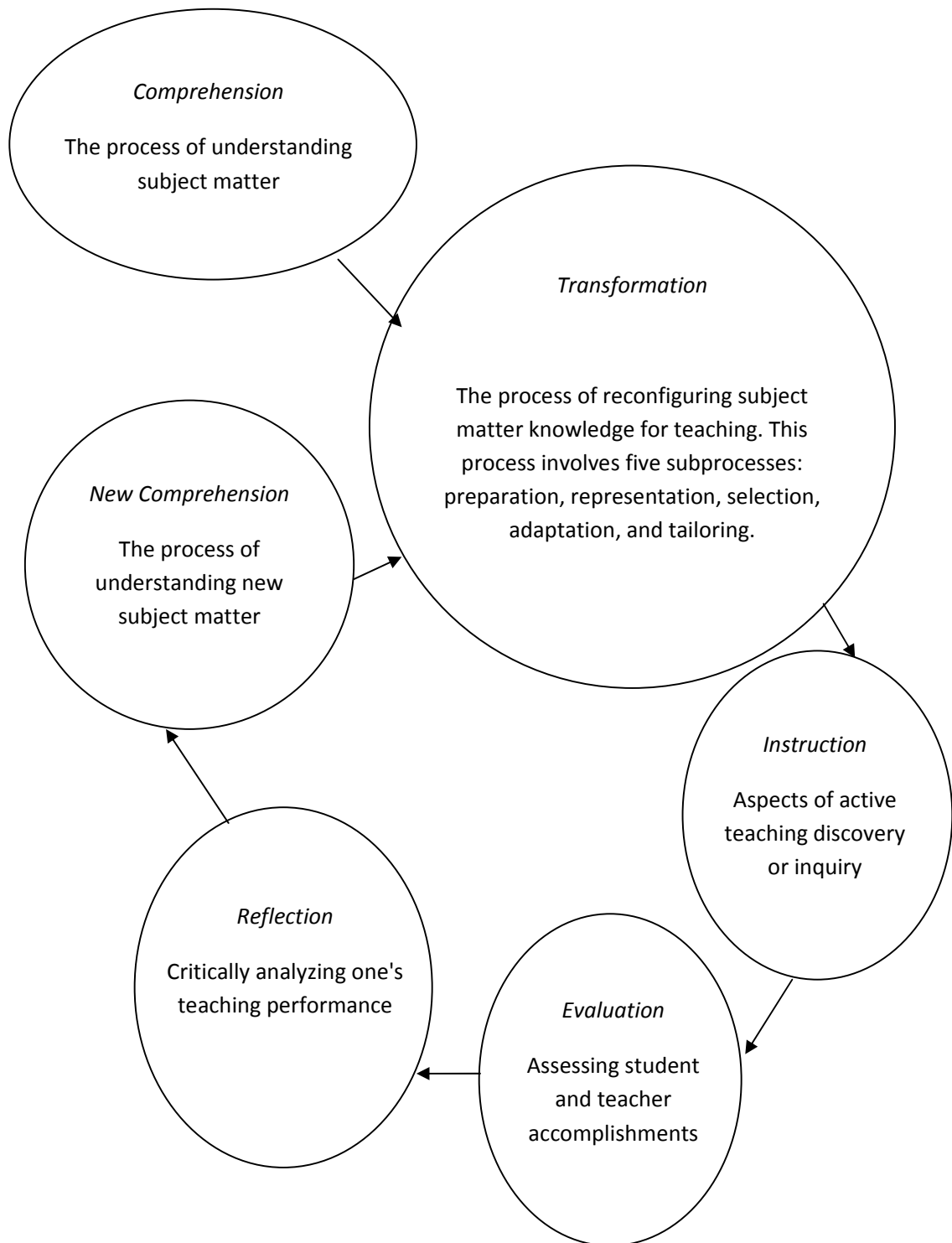


Figure 2.2. The Model of Pedagogical Reasoning (Wilson, et al., 1987)

Regarding PCK among teachers in Namibia, the Enviroteach programme was implemented in the teachers' colleges to sensitize teacher educators involved with Basic Education Teachers

Diploma (BETD) and students to environmental issues, and to encourage them to promote learner-centred education, activities-based lessons and cross curricular approaches to teaching using environmental education at all levels of the formal system. The Enviroteach integrated environmental themes and activities into the BETD modules, integrated environmental themes and activities into teachers' guides appendices and investigated approaches to environmental education within the SADC region and identified how they could be adopted in Namibia or how Namibia's approaches could be shared elsewhere. All this was done to improve teachers' pedagogical knowledge and content knowledge for EL.

As mentioned earlier in this chapter, the Life Science and SEEN project also played a role through NEEC for professional growth of educators in the field of environmental education. All three projects have made contributions to PCK, supporting teachers for implementing EL in Namibia, as shown in Table 2.1 below.

**Table 2.1 PCK guidance to Biology teachers by various projects for better EL implementation**

<b>Project</b>	<b>Subject matter</b>	<b>Pedagogical guidance</b>	<b>Assessment guidance</b>
Life Science	<ul style="list-style-type: none"> <li>•Food production, livestock</li> <li>• Tree planting</li> <li>•Importance of conservation, wise use of natural resources</li> <li>• Human Biology (Health and family planning issues)</li> </ul>	<ul style="list-style-type: none"> <li>•Practical skills</li> <li>•Focus on environmental projects</li> <li>•Professional development</li> </ul>	<ul style="list-style-type: none"> <li>•Practical assessment</li> <li>•Reflection</li> </ul>
Enviroteach	<ul style="list-style-type: none"> <li>•Booklets on environmental issues, indigenous and local knowledge</li> </ul>	<ul style="list-style-type: none"> <li>•Local issues analysis.</li> <li>•Integration of EL across curriculum,</li> <li>•Professional development,</li> </ul>	<ul style="list-style-type: none"> <li>•Assess knowledge, values and skills.</li> </ul>
SEEN	<ul style="list-style-type: none"> <li>•Teaching and learning materials such as fact sheets, notes, curriculum guidelines, booklets, on environmental issues in Namibia, focused on conservation and development issues,</li> </ul>	<ul style="list-style-type: none"> <li>•Promote enquiry based and active participation approaches,</li> <li>•Integration of environmental and sustainability issues into curriculum,</li> <li>•Professional development (NEEC),</li> <li>•Cluster system,</li> <li>•Whole school approach</li> </ul>	<ul style="list-style-type: none"> <li>•Assess knowledge, values, skills and action</li> <li>• Reflection.</li> </ul>

UNDES	•Local and global issues on sustainable development	•Active learning, • Integration of ESD in education.	•Reflection.
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Relevant to this study was thus to observe whether the Biology teachers do plan lessons that incorporate PCK's cycle of activities to be contained in teaching, and whether guidance for PCK and EL has influenced Biology teachers in the study. Shulman (2004) clearly states that, lesson plans ought to show learning and teaching support materials, and assessment approaches to be used. This helps teachers to review their lessons afterwards, which then constitutes reflection. Thus, to plan meaningful EL in Biology, teachers need to know how to design appropriate activities that will stimulate learners.

The PCK theoretical framework also helped me analyse and explain not only what EL teachers teach, but *how* and *why* Biology teachers implement EL the way they do.

Shulman (2004) further indicated that, a skilful teacher figures out what students know and believe about a topic and how learners are likely to hook into new ideas. Teachers should foster individual excellence involving equality of opportunity and equity among students of different backgrounds and cultures. Rosenberg (2008) and Haingura (2009) both indicate that EL helps to understand and use learners' prior knowledge and experiences and make learning connections. Like Stevenson (1997), Shulman (2004) notes that, teachers need several kinds of knowledge about learning. Teachers also need different kinds of materials for different purposes, to identify learners' strengths and weaknesses, curriculum resources, technologies that help learners explore, acquire and synthesize information, and frame and solve problems and make sense of the world. Teachers need to know about collaboration, how to structure interaction among students. PCK includes an understanding of the conceptions and preconceptions that students of different backgrounds bring with them to learning.

Beyer, Delgado, Davis and Krajcik (2009) observed that teaching is a complex practice. In order to deal with its complexity, teachers need strong subject content knowledge. But Kapyla, Heikkinen and Asunta (2009) argued that, knowing the subject content is not enough. Teachers also need to know how to teach it and how to help their learners understand it. Therefore, PCK entails having knowledge of the difficulties learners face in learning the subject matter and how

to deal with such difficulties. According to Van Driel et al. (1998), PCK develops through teachers training and teaching experience. They further stated that lack of PCK influences the planning of the lesson and probably would also make the real teaching difficult. Kapyla et al. (2009) state that Biology teachers in general are faced with insufficient content knowledge which results in insufficient learners' knowledge, lack of time, motivation and discipline. Thus, with regard to helping students develop their understanding of EL in Biology, teachers need to develop their PCK on environmental topics; they need to have knowledge of their students' ideas about EL. According to Beyer et al. (2009), curriculum designed to promote teachers' learning about the subject matter. They further stated that curriculum materials are connected to the teacher's daily work and thus can situate their learning in their own practice.

In terms of teaching EL in Natural Science (i.e. Biology), Peden (2008) proposes that to adequately address environmental issues, deep knowledge from Natural Science and Social Science is a prerequisite for critical thinking. She argued that, without an understanding of the science of key environmental issues one is doomed to superficial and inappropriate responses. Rosenberg (2004 cited in Peden 2008) observes that weak Natural Science knowledge of teachers in South Africa leads to the exclusion of the natural environment from environmental education; this may also be the case in Namibia. Peden (2008) indicates that teachers have superficial knowledge on environmental issues, a finding also reported in the Life Science, Enviroteach, SEEN and South Africa NEEP projects. Peden further indicated that although environmental education is meant to cut across the entire curriculum, it is rarely addressed by teachers other than those in Geography and Natural Science.

Fien (1993) and Cotton (2006) clearly note that, what the teachers teach is considerably influenced by what they know and feel. They further stated that untrained teachers cannot produce environmentally literate learners. Hence, teachers are the key determinants in EL implementation in class and their concerns and attitudes are in turn an influential factor. Stimpson (1997) argued that, the more successful teachers in implementing EL are those who have university degrees, those who are more interested in the environment, those who have more students who showed interest in the environment, and those who use different teaching strategies.

Delpit (1995) criticizes some of the assumptions of PCK, and notes that the relationship between knowledge of the learners and pedagogical content knowledge might be more significant than the relationship between subject matter content knowledge and pedagogical content knowledge. However a research paper by Lotz-Sisitka (2009) shows that to the teachers PCK is a vital element of enabling learners' knowledge to be successfully mobilised in the teaching and learning process. Delpit (1995) argued that a consideration of cultural influences on teaching styles must accompany any teacher assessment strategy. While, Grimmett and MacKinnon (1992) placed special emphasis on knowledge of motivation, knowledge of resources and technology, and knowledge about collaboration, they also considered the recognition of the problems individuals have learning, knowledge about how individuals' best learning, and learner motivations as part of pedagogical learner knowledge.

The above findings and Cotton's (2006:237) clear observation that "teaching of environmental issues raises a number of pedagogical challenges for teachers" indicates the importance of a focus on PCK for understanding how Biology teachers implement EL.

## **2.10 Conclusion**

This chapter has attempted to provide a contextual and theoretical framework for the study specifically relating to the state of environmental education in Namibia, other southern African schools as well as schools in other parts of the world. The topics on the integration of environmental education into existing curricula, methods of teaching and challenges faced by educators in teaching, have constituted the bulk of the discussion in this chapter. Many of the environmental education related challenges proposed in the literature, can be empirically investigated in the Namibian education landscape with specific reference to EL in the Biology curriculum. Insights generated through this literature review also helped me make sense of the data collected within this study (see Chapter 5). In the next chapter I discuss the research methodology.

## **CHAPTER 3**

### **RESEARCH DESIGN DECISIONS**

#### **3.1 INTRODUCTION**

In this chapter I describe and justify the choice of research methods for the study. I explain the interpretive design of the research and discuss the use of the case study method. I also describe the sampling of participants for the study and the data collection methods (primary interviews, lesson observations and document analysis), and explain how I sought to resolve issues of validity and how I set about analyzing the data. I end the chapter with a brief discussion of some of the limitations of the study.

#### **3.2 AN INTERPRETIVE RESEARCH ORIENTATION**

The study is guided by the interpretive paradigm and is constituted as a qualitative case study. This paradigm is “interested in the meaning that people make out of the phenomena” (McMillan & Schumacher, 2006:317). Interpretive orientations allow for an opportunity to understand the situation of the phenomena being studied by learning through the process of interaction. Cohen and Manion (1994:37) stated that “interpretive researchers begin with individuals and set out to understand their interpretations of the world”. Qualitative research allows obtaining a holistic picture of what goes on in a particular situation, in this case in the Biology classroom. According to Terre Blanche, Painter and Durrheim (2006), interpretive case study is characterized by a particular ontology, epistemology and methodology.

Ontology specifies the nature of reality that is being studied, and what can be known about it. Epistemology specifies the nature of the relationship between the researcher and what can be known. Methodology specifies how researchers may go about practically studying whatever they believe can be known (p. 6).

The researcher working in this tradition assumes that people’s subjective experiences are real and should be taken seriously, that we can understand other’s experience by interacting with them and listening to what they tell us.

Drawing on the above ideas, the study was designed to provide rich insights and understanding of the participants' views, beliefs, perceptions and practices regarding the implementation of EL in the Biology curriculum.

### **3.3 CASE STUDY METHOD**

This study takes the form of an interpretive case study method involving two schools in Windhoek, Namibia. Ary, Jacobs, Razaviech and Sorensen (2006) state that a case study seeks to understand the whole individual or phenomenon in the totality of that individual's or phenomenon's environment. Not only the present actions of an individual but his or her past environment, emotions and thoughts can be provided. A case study therefore enables the researcher to describe a particular case in depth, in detail, in context, and holistically (*ibid.*). Patton (1990) observes that case studies become particularly useful where one needs to understand a particular group of people, a particular problem or a unique situation in great depth, and brings out the issue of context and history of the issue under investigation. Stake (1995) explains that a case study enables the collection of information that is specific to the particular case and that the idea of a case study is to understand a particular case under study.

Denzin (1989) argues that case studies will often be the preferred method for interpretive research because they are epistemologically in harmony with the reader's experience and thus to that person's natural basis for generalization. But, Clough and Nutbrown (2007) argue differently as far as generalization of case study is concerned. To them case study results are particular to a context and can therefore not be generalized because they cannot be replicated in different settings. Le Roux (2001) seems to support this view when she indicates that data acquired in a case study provides a description of current conditions and that a series of case studies (one or more) may reveal information that might help in forming a new idea for further research. This means that the results are not generalized but are context based and are useful for further investigation of the issue revealed. The findings of this study will not be used to generalize how Biology teachers implement EL, but will be used to generate recommendations for further research (see Chapter 6).

### 3.4 SAMPLING

The study was conducted in Windhoek, Namibia. There are about 34 Secondary schools in Windhoek that offer Biology at Grade 11 and 12 level. Only two public secondary schools (coded school X and Y) were used for this study. The information from the pilot school (school W) was also used in the study. Purposive sampling was used to select the three schools. Leedy and Ormrod (2005) stated that, in purposive sampling, participants are chosen on purpose, because they are likely to be knowledgeable and informative about the phenomena the researcher is investigating. I considered this approach to be the most appropriate for my sampling purposes. Participants were a total of six Grade 11 and 12 Biology teachers, two from school X (index coded T1 and T2), two from school Y (index coded T3 and T4) and two from the pilot school, school W (index coded P1 and P2). The use of two schools in Windhoek was because of convenience and time constraints. The two schools where the study took place have a diversity of learners and teachers and they were the most easily accessible to me as a researcher.

I had easy access to these particular schools and three of the teachers who participated were known to me, in fact they were in my class at university. Through them it was also easier to work with their Biology colleagues that were unknown to me prior to the study. I met with all teachers several times (see Table 3.1 below for details of the visits conducted with different teachers) this made it easier for me to get used to them and continue communicating with them after the data collection. The table below shows the number of times the teachers were met, the dates and reason for the visit. The profiles of the teachers are contained in Chapter 4 (see Section 4.2).

**Table 3.1 Teachers visits during the study**

<b>Teacher</b>	<b>Date</b>	<b>Purpose of visit</b>
P1	16/05/2011	Explain purpose of visit
	18/05/2011	Signed consent letter, collected timetable, set dates for observations and interviews
	19/05/2011	Interview, observation (LO1)
	20/05/2011	Observation (LO2)
	23/05/2011	Wrap up visit
P2	16/05/2011	Explain purpose of visit
	18/05/2011	Signed consent letter, collected timetable, set dates for observations and interview
	19/05/2011	Interview
	20/05/2011	Observation (LO3)
	23/05/2011	Observation (LO4), wrap up visit
T1	18/05/2011	Explain purpose of visit, signed consent letter, collected timetable, set dates for observations and interview
	4/07/2011	Interview, Observation (LO5)
	12/07/2011	Observation (LO6)
	13/07/2011	Observation (LO7)
	15/07/2011	Wrap up visit
T2	18/05/2011	Explain purpose of visit, Signed consent letter, collected timetable, set dates for observations and interview
	27/06/2011	Interview
	28/06/2011	Observation (LO8)
	29/06/2011	Observation (LO9)
	30/06/2011	Observation (LO10)
	01/07/2011	Observation (LO11)
	15/07/2011	Wrap up visit
T3	20/05/2011	Explain purpose of visit, signed consent letter, collected timetable, set dates for interview and observations
	1/07/2011	Interview
	4/07/2011	Observation (LO12)
	5/07/2011	Observation (LO13)
	6/07/2011	Observation (LO14)
	7/07/2011	Observation (LO15) , wrap up visit
T4	20/05/2011	Explain purpose of visit, signed consent letter, collected timetable, set dates for observations and interview
	27/06/2011	Interview, Observation (LO16)
	28/06/2011	Observation (LO17)
	29/06/2011	Observation (LO18)
	7/07/2011	Wrap up visit

### **3.5 DATA COLLECTION TECHNIQUES**

The methods used to collect data include document analysis, lesson observations and semi-structured interviews. Each of them is discussed in detail below.

#### **3.5.1 Document analysis**

Stake (1995:68) suggests that gathering data by studying documents follows the “same line of thinking as observing and interviewing”. Hopkins (1993) notes that, document analysis is important because it provides information and understanding of what is happening in the classroom. It is for these reasons that I decided to use this strategy. Document analysis provided me with evidence of how Biology teachers are expected to implement EL in their respective classrooms based on the Namibian Ministry of Education requirements. Analyzing documents was done throughout the study. The initial analysis of documents was used to serve as a frame, which informed the interview schedule and the observation checklist. After interviews and observations, analysis of documents was done as a means of reference on what was observed and said during the interviews and observations. The key documents analysed were indexed and given a code to make it easy for data analysis, the coding systems used for documents are as follows:

- The syllabus- D1
- The subject policy- D2
- The teachers guide-D3
- The textbook-D4

I reviewed and analysed the content of the official Biology curriculum documents such as the textbook, teacher’s guide, and subject policy guide, scheme of work and syllabus. This formed the first baseline analysis, and helped me gain insight into the expected EL implementation in Biology classrooms. Content analysis in documents was guided by the research questions. It involved extracting the relevant text and analyzing it. Lesson plans and teaching materials were analysed to help me see if there is any link between what the documents say and what has been observed. PCK in documents was analysed to identify how EL should be taught.

A sample of question papers were analysed to gain insight on how EL is examined and to see whether that has an influence on implementation of EL. Analyses of question papers was also done to see patterns across the papers, to identify which areas of EL are examined most and to see which assessment objectives are examined most in terms of EL. However, only the specimen papers for ordinary and higher level that were compiled with the introduction of the NSSC Biology syllabus were used for in-depth analysis. The papers were analysed based on syllabus assessment objectives (see Table 4.1A and 4.1B). However, no Paper 1 (the multiple choice paper) for ordinary level was analysed because there was no sample provided for that paper.

### **3.5.2 Semi-structured interviews**

The second major method of data generation was through interviews with the Biology teachers. The purpose of conducting interviews was to seek more in-depth answers to my research questions. McMillan and Schumacher (2006) regard an interview as a purposeful interaction usually between two people, focusing on one person trying to get information from the other person. Leedy and Ormrod (2005) state that interviews allow the researcher to investigate and prompt things that one cannot observe. They further noted that, through semi-structured interviews one can probe an interviewee's thoughts, values, prejudices, perceptions, views, feelings and perspectives. It is in this context that I conducted semi-structured interviews with the Biology teachers. I developed an interview schedule to guide the interview (see Appendix 2). Drawing from Terre Blanche et al. (2006), in terms of quality and understandability of the questions I was asking, the interview schedule was pilot tested with two teachers before it was used in the actual study. Piloting of an interview schedule was done to help reformulate or redirect the study to help the teachers provide detailed explanations on how they implement EL and the enablers and constraints thereof. There were, however, few changes and the data gathered during the piloting were seen to be relevant for the study, and have therefore been used in the study.

During the interviews each teacher was asked questions that allowed them to reflect on their personal and professional influences and experiences that may have contributed to the implementation of EL. Probing was done when participants did not answer the question or when a key point was raised that needed further clarification. All interviews were planned for the

afternoons so that there would be no conflict with teaching activities or core functions of the school. One teacher could not fit me into her afternoon schedule, thus we agreed to conduct the interview during one of her administration periods, I felt pressed for time but we managed to finish the interview. The duration of the interviews varied from 27 to 45 minutes depending on how the participants responded. All the interviews were conducted at schools for the comfort of the teachers.

I am, however, also aware that an interview has certain limitations as Bell (1993:91) identified it as “a highly subjective technique and therefore there is the danger of bias” Despite this shortcoming, I found using interviews valuable, particularly because of the semi-structured interview format that I deployed. By using the semi-structured interviews, I was able to get detailed and rich responses from the respondents. These interviews enabled the respondents to have freedom and engage in rich conversations through which they could easily explore their thoughts without the fear of being limited by closed questions.

Drawing on Clough and Nutbrown (2007), permission was requested from participants to use an audio recorder to obtain interview data and to avoid losing some comments. The audio recorder was used to capture the respondent’s unique expressions as well as to enable me to transcribe the interviews. The audio recorder was convenient as the researcher has to concentrate on eliciting responses without losing what is being said while taking notes. Using an audio recorder is less time consuming as one can sustain the interview sessions without pausing for note-taking.

Teachers’ names were not attached to the interview quotations but were given transcription indices (see Section 3. 4) to protect their identities in case they wished to provide sensitive data.

### **3.5.3 Observation**

After interviews, lesson observation was done to give me an opportunity to both build on and complement the responses given by the respondents in the interview. Stake (1995) indicated that, the importance of using observation is to increase understanding on the case being studied. Bell (1993:109) notes that “direct observation may be more reliable than what people say in many instances. It can be particularly useful to discover whether people do what they say they do, or behave in the way they claim to behave”. Cohen, Manion and Morrison (2007:396) state that

observation “offers an investigator the opportunity to gather ‘live’ data from naturally occurring social settings, the researcher can look directly at what is taking place *in situ* rather than relying on second-hand accounts”.

I am aware of the weaknesses of observation method, as noted by Simpson and Tuson (2003) that observation has a high demand on time, effort and resources. I went about solving this weakness by piloting my observation and procedures so that I could make a fair estimate at the outset of how long the data collection and process might take. That also helped me plan the study within the limits of my resources. Simpson and Tuson (2003) further note that observation is susceptible to various factors, one being bias, which might occur either because the observer records what he or she *thought* occurred rather than what *actually* took place, or because of the observer’s lack of attention to significant events. To solve this weakness, classroom observation was done in conjunction with informal follow up discussions. Follow up discussions were done with the Biology teachers in order to give them the chance to clarify issues or matters that arose during their lesson presentations and to check interpretation of observation.

In light of the above ideas, seven Grade 11 and 12 Biology lessons were observed from each of the two selected secondary schools. I initially planned to observe at least five lessons from each teacher. But due to obstacles of teachers not teaching some lessons, some teachers were observed three times and others four times depending on their availability. Before the actual data collection, four lessons were observed as part of piloting. In total 18 lessons were observed, from lesson 1 to lesson 18 they are index coded LO1-LO18. I took notes of everything in the lessons and that helped me make sense of them before I could embark on the actual observation for the study. Four lesson observations used for piloting were also used in this study as I found the data gathered during the pilot phase was also useful and relevant to the study. In total eighteen lessons were observed from the three schools. Even though I was more interested in EL lessons being taught in the Biology classrooms, it did not limit me from observing other Grade 11 and 12 Biology topics taught by the selected teachers during the data collection period. Time of observation was determined by the school timetable. The duration of observation was determined by the duration of the lessons. Most lessons lasted for 35 minutes on average.

As a non-participant observer, I tried to minimise description associated with my presence by taking a seat at the back of the classroom and not saying anything during the lessons. I deployed

a semi-structured observation checklist. An observation schedule was prepared but the observations were not confined to these (see Appendix 3). The checklist incorporated ideas associated with the PCK cycle of activities: comprehension, transformation, instruction, evaluation and new comprehension (see Section 2.9 above). There was a conscious effort to observe other unexpected or unanticipated actions and utterances which might give clues as participants were responding to changes in the teaching methods (Cohen et al., 2007).

The primary focus during lesson observation was to understand the teachers' interactions with the students, teaching methods being used, and the teachers stated goals as compared with the actual content and activity during classes and types of assessment. Observations also had to focus on events as they happen in the Biology classroom; for example, verbal interactions between teachers and students, the number of learners in the classroom, the teaching and learning materials used to present EL lessons and the seating arrangements in the classrooms.

I took notes of any written work on the chalkboard and transparencies and teaching aids used. I also negotiated with the teachers to get copies of printed handouts, worksheets, or pages from books used during the teaching periods. It was also necessary to observe the teachers' non-verbal gestures to see how confident they are in presenting the lesson and as an indicator of interaction.

I also observed specific factors that influence the lessons (for example class size, resources used, time spent on tasks etc.) to provide further perspective on the enabling and constraining factors of EL implementation.

### **3.6 DATA ANALYSIS**

According to Gay, Mills and Airasian (2006), data analysis is the process of making sense and finding meaning in the data, interpreting what has been seen and what has been said. Qualitative analysis is a relatively systematic process of coding, categorizing and interpreting data to provide explanations of a single phenomenon of interest. Data generated was inductively analysed, the focus was on how Biology teachers implement EL in their classrooms. Through the use of inductive analysis, categories and patterns primarily emerge from the data, rather than being imposed on them prior to collection (Davies, 2007). Data was colour coded (see Appendix 5) to assist me in making sense of the data.

All of the interviews were transcribed and the transcriptions of observations were interspersed with the corresponding field notes. Data generated through interviews was analysed under broad themes and writing of summaries and tables, which are related to the interview schedule and the questions asked during the interview process. These were then organized into categories and subcategories using a constant comparative approach, by reading across all the transcripts. During analysis the data was revisited often to ensure that themes and categories genuinely emerged and were not imposed and the essence of the dialogue was preserved (Patton, 1990). Analytical memos were produced containing broad themes and headings. The analytic memos were determined by the interview questions (see Appendix 4). I have used extensive direct quotations from the teachers to enable their ideas to come through in this study. I was able to generate analytical statements to help reduce the data. According to Bassey (1999) analytical statements are based on raw data but speak directly to the research questions.

Data generated through reviewing of documents and observations was also analysed by writing up summaries, inductively coding it and then interpreting it; using the pedagogical reasoning model to seek for evidence of knowledge; comprehension, transformation, instruction, evaluation, reflection and new comprehension. The coded data is also represented in analytical memos so that evidence of PCK is documented in analytical statements.

### **3.7 VALIDITY AND TRUSTWORTHINESS**

According to Bassey (1999:75), “validity is an extent to which a research fact or finding is what it is claimed to be”. To ensure validity and trustworthiness in the study, I used three methods of data collection, semi-structured interviews, lesson observations and document analysis. The use of multiple methods helped to triangulate and to build on each type of data collection while at the same time compensating for potential weaknesses in any single approach (Patton, 1990). Triangulation was used to complement and look for consistency, patterns and discontinuities in the data collected.

For validity and trustworthiness in this study, I also used interpretive validity and descriptive validity. According to Maxwell (1992:288), interpretive validity can be described as, “appropriate primarily because this aspect of understanding is most central to interpretive research, which seeks to comprehend phenomena not on the basis of the researcher’s perspective

and categories, but from those of the participants in the situations studied”. For descriptive validity, I paid attention to “issues of omission as well as commission” acknowledging that “no account can include everything” (Maxwell, 1992:287). However, I tried to ensure that constructs are accurate and constructs are those presented by respondents. My interpretation of interviews relied as much as possible on the participants’ own words and concepts (interpretive data). Based on this understanding the information, which I reported in Chapter 4, was as true to the intended meanings of the educators as possible. As indicated earlier in the chapter, the audio recorder and field notes were used to capture the data and reflect on what had been interpreted. Through careful transcription, thick description was made possible to ensure that I was realistically interpreting their meaning.

Using follow up discussions after observations and member checking of interview transcripts gave me an opportunity to share the interpretations with the Biology teachers in order to corroborate the data. Reflexivity was considered throughout the research process, as Bassey (1999) states that interpretive research requires researchers to be aware of the standpoint from which they conduct the research. I kept reflecting on my intentions throughout the data collection process. I was aware of my role within the research process and how that might have influenced the participants and data generated. In order to guard against being biased, I tried to examine my assumptions critically as potential threats to validity. It was never my intention to ‘prove’ a particular perspective or manipulate the data to arrive at predisposed truths (Patton, 1990). What I did was try “to understand the world as it is, to be true to complexities and multiple perspectives as they emerged, and to be balanced in reporting both confirming and disconfirming evidence” (Patton, 1990:55).

### **3.8 ETHICS OF THE STUDY**

Careful attention was given to ethical issues that I encountered. According to McMillan and Schumacher (2006), this includes policies regarding informed consent, safety, deception, confidentiality, anonymity, privacy and caring. Permission to conduct research at the schools was first requested from the selected school principals by writing a letter seeking consent and from the Biology teachers (see Appendix 1). Informed consent forms contained the following information, which was drawn from Leedy and Omrod (2005:102); a brief description of the nature of the study, voluntary participation, guarantee that all responses will remain confidential

and anonymous, a place for participants to sign and date the letter indicating agreement to participate, researcher's name, plus information about how the researcher can be contacted. Drawing on Bassey (1999) I negotiated a formal agreement with participants in which I informed them about their rights to withdraw from the study at any time they felt that it was necessary without penalty. Permission to record the interviews was sought from the participants and they were informed that I would stop recording at any time that they wished. Participants were guaranteed of their full rights to verify the data and to get a copy of detailed information about the study (summary of findings) upon its completion.

### **3.9 LIMITATIONS**

The study has only used three schools in Windhoek. Thus as indicated earlier in Section 3.3 the data will not be used to generalize how Namibia Biology teachers implement EL in Grade 11 and 12. The findings were not a true representation of how EL is taught in all the senior secondary Biology classrooms in Namibia as a whole. The research results might have been different if educators from various areas, such as semi-urban and rural areas were involved in the study. This was impossible because of financial, time and geographic constraints. Despite these limitations, the study provided an initial understanding of Biology teachers' ways of implementing EL in the Namibian schools involved in the study and some implications for curriculum and teachers' development for EL in the future became evident.

### **3.10 CONCLUSION**

In this chapter I have provided details on the research design decisions which informed the research process, the methodology which was chosen for approaching the research and the methods used for carrying it out. The justifications for choosing those particular orientations, approaches and methods were explained. The methods for coding the data are elucidated. The chapter explained how I attempted to reduce bias through constant comparison of data using triangulation and reflexivity. Finally the chapter has provided an exposition regarding ethics of the study. In the next chapter I present the data.

## **CHAPTER 4**

### **ENVIRONMENTAL LEARNING IMPLEMENTATION: EXPECTATIONS, TEACHERS' VIEWS AND TEACHING PRACTICES**

#### **4.1 INTRODUCTION**

In this chapter I have compiled data that emerged from a preliminary analysis of the semi-structured interviews, selected curriculum documents and lesson observations. The data describes how teachers implement EL within the Biology curriculum, at Grade 11 and 12 level and how they understood the teaching of the environmental topics in three selected schools in Windhoek (Khomas region). The presentation of data uses the following analytical categories: curriculum expectations (see Section 4.2); teachers' views on the teaching of EL (see Section 4.3); and teaching practices (see Section 4.3) which describes actual teaching practice. Enabling and constraining factors are identified throughout. These draw on the structure of the interview and a thematic approach for interpreting the lessons, syllabus, teacher's guides and other curriculum documents. As indicated in the methodology chapter, 'thick descriptions' were used where relevant to add to the authenticity of data and description.

#### **4.2 CURRICULUM EXPECTATIONS**

##### **4.2.1 The syllabus**

###### **4.2.1.1 Content, skills and values**

The syllabus is the policy document that should inform and shape all teachers' teaching. It provides the guidelines on what teachers should teach in order to develop learners' understanding on the specific topics, the general objective and specific objectives that learners should achieve. The Biology NSSC syllabus occurs in two types, higher and ordinary level to accommodate learners with different learning abilities. The difference between the higher level and ordinary level is mainly in the type of examination papers written and the lesson objectives to be achieved (see Tables 4.1A, 4.1B and Table 4.7). This syllabus is designed as a two year course after the completion of the Junior Secondary Phase (JSP), to be covered in Grade 11 and 12. The rationale of the Biology syllabus is to increase the learners' knowledge and understanding of the physical and biological world of which they are part, including understanding how people use the natural environment to satisfy human needs, and how the

environment may be changed in ecologically sustainable ways. Critical thinking, investigating phenomena, interpreting data and applying knowledge to practical skills are essential for understanding the value and limitations of natural scientific knowledge and methods, and their application to daily life. The application of scientific knowledge and attitudes to health is of special relevance for the individual, the family and society as a whole.

Some of the Biology issues and activities are closely related to the environment and hence EL. The syllabus analysis identified the syllabus issues which are more explicit to EL aspects. The aims of the NSSC Biology syllabus are more or less consistent with Environmental Education Policy Framework of Namibia (see Chapter 1). A few examples of the explicit aims of the syllabus in relation to EE policy are highlighted as follows: “*To stimulate interest in, and care for the environment and to promote awareness that the application of science may be both beneficial and detrimental to the individual, the community and the environment*” (pp.2-3). The broad aims specify a requirement for ‘care for the environment’ and an awareness of the limitations of science and the impact of science on the environment has not been completely addressed within the specific curriculum content.

The syllabus themes, topics, general objectives and specific objectives revealed a considerable amount of explicit information covering environmental issues. Section 4 of the syllabus is about ‘the relationships of organisms with one another and their environment’. This section covers the following topics:

- *Energy flow, food chains and food webs:* Understand the flow of energy through an ecosystem;
- *Nutrient Cycle:* Describe the role of micro-organisms in an ecosystem for example the role of bacteria as decomposers. To understand the importance of nutrients to be cycled in the biosphere;
- *Population:* Demonstrate an understanding of the impact of humans on the environment. Assess alternative courses of action to protect the environment;
- *Human influences on the ecosystem:* Understand the importance of sustainable agriculture for the country; explain how water may be polluted by agricultural practices; discuss how

poor agricultural methods result in destruction of the ecosystem; list and describe the principle causes of deforestation and its harmful effects, investigate the effects of human population growth on the environment and the quality of life, for example, effects on the ecosystem and explain the dangers to the environment of the excessive use of fertilisers;

- *Agriculture*: An opportunity for considering the ‘green revolution’ its ‘cons’ as well as its ‘pros’ should be incorporated. Similarly, the increase in food production through genetic manipulation is an ethical issue which may have a range of consequences. Desertification is not explicitly mentioned;
- *Pollution*: Explain how pesticides can cause death to wildlife. Describe how the use of pesticides impacts on the environment. Discuss the causes and effects of acid rain on the environment and measures that might be taken to reduce its incidence; and
- *Conservation*: Discuss the need for conservation of species, the advantages and disadvantages of tourism conservation. Describe importance of local and international conservation projects.

The other sections of the syllabus also cover some learning objectives and topics that are relevant to EL, these include:

- *Characteristics, classification and diversity of living organisms*: Understand the diversity of organisms and their adaptations to different environments (to be illustrated by Namibian examples wherever possible);
- *Sexually Transmitted Diseases (STD’s)*: Describe the cause, symptoms, signs, effects and methods of transmission of STD’s and the ways in which it can be prevented from spreading. Discuss the increased vulnerability of Namibians to other illness due to the increased prevalence of HIV and AIDS. Discuss the socio-economic consequences of the HIV and AIDS pandemic for Namibia;
- *Nutrition (plant and animal)*: Understand importance of nutrition in living organisms; and
- *Drugs*: Describe the effects of alcohol and drug and alcohol abuse.

#### 4.2.1.2 Assessment

All Grade 11 and 12 learners write three examination papers in Biology regardless of their levels. As indicated in the tables below, learners are required to demonstrate the assessment objectives in the context of the content and skills prescribed.

**Table 4.1 A Paper weightings allocated to different assessment objectives (ordinary level).**

Assessment objectives	Overall weighting across components	Paper 1	Paper 2	Paper 3
A Knowledge with understanding	50% (not more than 25% recall)	20 marks	55 marks	25 marks
B Handling information, application and solving problems	30%	20 marks	35 marks	5 marks
C Practical (experimental and investigative ) skills and abilities	20%	0 marks	10 marks	30 marks
		40 marks	100 marks	60 marks
Total : 200 marks				

(Source: Namibia. MoE, 2005:30)

**Table 4.1B Paper weightings allocated to different assessment objectives (higher level).**

Assessment objectives	Overall weighting across components	Paper 1	Paper 2	Paper 3
A Knowledge with understanding	40% (not more than 20% recall)	24 marks	55 marks	5 marks
B Handling information, application and solving problems	40%	40 marks	39 marks	5 marks
C Practical (experimental and investigative ) skills and abilities	20%	6 marks	6 marks	30 marks
		70 marks	100 marks	60 marks
Total : 210 marks				

(Source: Namibia. MoE, 2005:36)

The assessment objectives are to a certain extent in line with those contained in the environmental education framework as indicated in the following statement extracted from the Biology syllabus, “*The assessment will include, wherever possible appropriate, personal, social,*

*environmental, economic and technological applications of Biology in a modern society”* (p. 32). The information is covered in different Assessment Objective areas of the syllabus, for example:

*Assessment Objective A: Knowledge with Understanding* (assesses learning content that learners need to recall and explain). Use of technological applications with social, economic and environmental implications (Which requires an understanding of the environmental impact of technology, how technology is made appropriate for the environment and how technology can lead to increased resource consumption).

*Assessment Objective B: Handling information, Application and Problem Solving* (requires learners to use principles and concepts that are within the syllabus and apply them in a logical, deductive manner to a novel situation). Use information to identify patterns, report trends and draw inferences (this could include environmental aspects) and present reasoned explanations for phenomena, patterns and relationship.

*Assessment Objective C: Practical Investigation and Skills* (assesses learners’ practical skills). Make, record observations and measurements and interpret and evaluate experimental observations of data (not quite explicit but include environmental aspects).

Table 4.1A and 4.1B above also show the weighting components of the different exam papers. For ordinary level (Table 4.1A) (50%) assess knowledge with understanding, (30%) for handling information and solving problems practical skills and (20%) for assessing practical skills. While for higher level (Table 4.1B), considerable emphasis is placed for assessment purposes upon knowledge with understanding (40%) and handling information and solving problems investigative skills (40%), while experimental skills weight 20%. These tables were used as a framework to analyse the different specimen exam papers to see how much EL is covered in the exam and to see whether that influences teachers’ implementation of EL (see Section 4.2.5). The different verbs are described in the syllabus based on the assessment objectives, for example; knowledge and understanding uses verbs such as define, name, list, indicate, give examples, state, describe, compare, explain, distinguish, outline and give reasons. Handling information, application and solving problems uses verbs like discuss, deduce, compare, discuss, find,

estimate, interpret, evaluate, sketch, predict, identify, relate, suggest, calculate or determine. Terms such as observe, demonstrate, investigate, measure, communicate, infer, draw conclusions, design are process skills questions and are also described in the syllabus.

The Biology syllabus has suggestions for practical activities or demonstrations that are considered essential (and which all learners should be exposed to), through coursework preparations for the practical examinations. For example, some of the practical activities suggested that are relevant to EL are: *“Investigate the effect of sulphur dioxide on plant seedlings, using matches as a source of sulphur dioxide”*.

*“Observe and draw organisms found locally, concentrating on diagnostic features and/or features that adapt them to their environment”*.

*Design and use a questionnaire to investigate two or more aspects of diet among a group of people - use food tables or computer programmes to estimate the amounts of different types of nutrients in a diet, and/or to plan a diet for someone with special needs, for example a pregnant woman, HIV positive/AIDS person.*

The syllabus also indicates that, the learning content outlined in the syllabus is designed to provide guidance as to what will be assessed in the overall evaluation of learners, and is not meant to limit teaching in any way.

#### **4.2.2 The subject policy**

The subject policy is a ministry policy document that should be consulted regularly by all subject teachers to ensure that they teach within the guidelines of the ministry. This policy document guides individual teachers to take initiative, especially in presenting the subject content and facilitating learning. The subject policy emphasizes the learner-centred approach for teaching, learning and assessment in Biology. The subject policy emphasised that utilisation of learners’ prior knowledge in teaching and learning is important for EL. The subject policy indicates that the learning process may be amplified by linking science and real life situations in the environment. The subject policy also indicates that learners should get well planned homework every day. Regardless of class size or teacher’s timetable, the teacher should personally mark and

monitor the work of each learner regularly to help her pick up academic constraints with certain learners. Teachers should write a critical reflection on lessons, noting how strategies could be changed to meet the lesson objectives and how the lesson should then be changed for future adaptation for teaching success.

The subject policy indicates that a variety of materials must be used to enrich and assist in achieving lesson objectives. Relevant to EL the subject policy states that teachers must improvise teaching and learning by using easily available objects in the immediate environment. Local environment and community can be used both as a field to be researched and as resources to obtain information, to stimulate investigation, for inquiry and creativity. The subject policy also states that every teacher should meet the requirements of the syllabus and should develop an effective scheme of work from the syllabus. The scheme of work should be adapted if the syllabus changes. Written lesson preparation is compulsory for every teacher, irrespective of experience. A successful lesson plan should include the topic, teaching aids, learning objectives, basic competencies, monitoring of homework, introduction, presentation of the subject content and assessment.

The subject policy emphasises that extramural activities should be available for learners to practice their knowledge and skills. The subject policy also emphasises the following key issues relevant to the study:

#### **4.2.2.1 Integration**

The subject policy indicates that EL is integrated across the curriculum.

#### **4.2.2.2 Support**

The subject policy indicates that effective implementation of EL depends on a good communication network between teachers, management, suppliers of material and equipment, community or/and parents, advisory teachers and other stakeholders in Science education by emphasising the following:

*Subject meetings and class visits:* The department of Sciences should conduct regular subject meetings in order to ensure a better implementation of the Natural Sciences, hence EL. These meetings should ensure that there is a dynamic process of feedback in both directions, from

management to teachers and vice versa. Meetings should serve as a tool for planning, the comparing of schemes of work and activities, such as the setting and moderation of examination papers, in-service training, workshops and temporary or permanent change of staff. Class visits should be conducted regularly by the school management, subject head and even senior teachers. These visits which should be done at least once per term must be constructive, giving positive feedback. In areas of concern, the visitor should lead the discussion in such a way as to make the teacher aware of possible shortcomings.

*Continuous professional development:* There should be workshops and in-service training of teachers. Teachers should share information, experiences and strategies they were equipped with during training. To excel as a teacher, and constantly develop teaching and management skills, the teacher should be engaged in continuous development programmes. Subject heads and heads of department should have the experience and training to assess the needs of the members of their staff. If the necessary expertise for the development of management skills to facilitate creative teaching is absent, then outside help (e.g. advisory teachers) should be sought. “*An advisory teacher has extensive knowledge of the relevant subject areas and their responsibilities are, amongst others, to ensure quality in education through rendering liaison services and subject guidance*” (p. 15). The school should fully utilise the expertise provided by advisory teachers. Alternatively school cluster meetings can be organized. There must be department training activities; these can be shared in cluster groups, and in the process with neighbouring schools.

*Cluster subject groups:* The purpose of cluster subject group meetings is to improve efficiency, build capacity and empower teachers. Attending and participating in cluster subject activities can play a positive role in collaborative development and improving quality teaching and learning.

#### **4.2.2.3 Resources**

The subject policy emphasise that teachers in Biology should be creative and innovative to produce their own teaching and learning materials linked to practice. Additional to the textbooks, each school should have a teachers’ guide, equipment used for laboratories, one or two teacher textbooks to use for class preparation and other resources (including ICTs). The supply of

suitable teaching aids that will ensure effective teaching must be seen as the joint responsibility between the Ministry of Education and the school. Teachers should use these to enhance learning and make teaching fun.

*Classroom displays and arrangement:* All classrooms should have displays such as wall charts, artefacts and learners' work which makes learning interesting. Materials can be prepared following discussion of the learners' experiences, stories or ideas. Teachers should encourage learners to add and change displays regularly. It should be the aspiration of the teacher to create an exciting, interesting and encouraging learning environment. The way in which teachers organise their classrooms and activities will have an effect on the atmosphere in the classroom as well as the activities. The seating arrangement may depend on the kind of activity or method planned for a particular lesson, e.g. demonstration, experiment.

*Textbooks and exercise books:* The ideal situation is that every learner has a textbook for Biology and a note book/ exercise book.

*Equipment, practical lessons and laboratories:* In lessons where the teacher intends to conduct some practical work by demonstration, learners themselves must be carefully prepared, and tasks tried out before hand. The time factor should always be considered in such a way that the activity can be mastered within the available time, or mechanisms developed for carrying on over more than one day.

*Teachers' resource centre and school library:* Teachers are encouraged to utilise the resources and facilities offered at teachers' resource centres. If a certain item is not available at the local/regional centre, it is possible to make inter-library or inter-teachers resource centre loans.

#### **4.2.2.4 Time and time management**

Success of EL depends on maximum time on task and it is expected that, the teacher and learners attend every class as indicated on the timetable, the teacher and learners arrive punctually in the morning for school and for every class, lessons are planned so that there is as much time on the task as possible. In terms of the timetable, the subject policy suggests that in the timetable, Grade

11 and 12 should have 6 Biology periods in a 5 day cycle or 8 periods in a 7 day cycle period with a minimum of 40 minutes duration per period. Natural Science (which includes Biology) gets at least two double lessons a week to provide enough time for discussions, practical work or experiments.

#### **4.2.2.5 Teachers' knowledge/qualification**

The subject policy indicates that teachers should be qualified to teach the subject phase and have knowledge of subject matter. In this case Biology teachers should have a qualification to teach Biology at Grade 11 and 12 level, hence EL within Biology.

#### **4.2.2.6 Learners' discipline and motivation**

The subject teacher should create a conducive environment in the classroom for quality teaching and learning and establish a disciplined teaching and learning environment in the class.

#### **4.2.3 The teachers' guide**

The teacher's guide is an official document which is meant to guide teaching and learning in the classroom and should be thus fully utilized for class preparation. The Biology teacher's guide is not a prescription but rather a guide for Biology teachers and it provides an overview of strategies and teaching approaches to the NSSC syllabus. It includes comments and recommendations made by examiners and markers from past examination papers. The teacher's guide is intended to supplement the Biology textbook and syllabus and not to be used alone. The content is based on the NSSC Biology ordinary and higher level syllabuses.

The content in the teacher's guide focuses on concepts, instructional text as well as laboratory activities that promote learners' expectations. It comprises ideas on possible difficulties and misconceptions that could be a barrier to learners' understanding Biology. It also includes practical demonstrations, for example, for the topic of water pollution, "*learners should carry out an investigation to compare oxygen demand in water from different sources, such as above and below a sewage outfall, using methylene blue as an indicator*" (p.78).

The teachers' guide has worksheets and suggested activities which are consistent with achieving the goals of the syllabus. The teacher's guide consists of assessment that helps the teacher to

assess learners' performance, for example, for the topic of agriculture it suggests that, by means of tables learners should compare the advantages and disadvantages of the use of modern technology in food production, briefly describe the undesirable effects of deforestation and to discuss the effect of nitrates from fertilizers to the organisms living in the pond of water.

Teachers are not necessarily expected to follow the pattern of the guide exactly, but they are encouraged to adapt it and/or make adjustments where necessary to suit their unique teaching environments. The teachers' guide has suggestions for materials to be used for certain topics, to make the lessons more practical, relevant and interesting and reflects the use of daily and local examples, such as for artificial selection, it suggests that, "*learners should use examples of selection by local commercial and subsistence farmers*" (p. 73), for food chains and food webs, suggests that learners should be able to, "*construct their own food chains and food webs using local organisms and for the conservation topic, learners will have an opportunity to discuss and propose different recycling projects in the community. If it is possible they should visit local recycling plants*" (p.79). For the purpose of this study, only the topics that were taught by the observed teachers were analysed in the teachers guide.

#### **4.2.4 The textbook**

The Biology textbooks have been written and designed to prepare students for the NSSC ordinary and higher level or similar examinations. The Biology textbooks are in three modules (module 1, 2 and 3). They were tailor-made to suit the NSSC syllabus. Only Namibia College of Open Learning (NAMCOL) attempted to review their materials to align them with the new syllabus. The Government (Ministry of Education) did not do that. They only changed the syllabus but did not attempt to localize study materials. Although the Biology textbook and teacher's guide have been developed for NAMCOL students and tutors, they are being used by full-time teachers and learners. Teachers and full-timers find the Biology textbook and teacher's guide to be more relevant to the syllabus. It is also user friendly.

The Biology textbook has subject matter that is organized in a logical manner in accordance with the syllabus objectives. The textbook EL topics are similar to the syllabus topics, such as conservation, pollution, population, food chains and food webs and agriculture (see Section 4.2.1.1). It consists of stimulating activities and exercises from past exam papers. The activity

questions are designed to encourage critical thinking and to facilitate learning and assess skills and knowledge such as, “*Why do you think we should try to conserve species in southern Africa?*” (p.182), “*Why do you think many schools and local communities collect waste paper?*” (p.187), “*Fluoride may be deliberately added to public water supplies. Explain as fully as you can, why you think that this is, or is not, an example of pollution*” (p.190), “*Why is it important to have clean water*” (p.192). The activities in the textbook are clearly linked to the syllabus learning objectives. Instructions for activities are clearly stated and practical investigation instructions are outlined step-by-step (see Appendix 9). However, the Biology textbook was developed for distance students. Thus, there is not much evidence of cooperative learning in the Biology textbook and the teacher’s guide. The Biology textbook addresses local environmental issues, examples on environmental issues such as monoculture, pollution, deforestation, soil erosion and overgrazing are all common in Namibia. The Biology textbook also clearly makes a connection between environmental problems that are not common in Namibia and the chances of occurring in Namibia, for example, on page 176 the Biology textbook also explains that, air pollution and acid rain caused by sulphur dioxide are not major problems in Namibia as there are not many industries that could release excessive toxic fumes into the atmosphere. However, learners should understand that toxic fumes can be produced in one part of the world and be transported by wind to other parts of the world where they could have major effects. Page 179 of the Biology textbook, explains that plastics are resistant to breakdown, they may be carried long distances, foam polystyrene granules are common on the beaches and some float all over the oceans of the world.

As indicated earlier, the Biology textbook has suggestions for practicals or demonstrations but not to a large extent, thus, they are more theoretical and focus more on the subject content rather than skills development. The goals are stated as learning objectives and are clearly stated at the beginning of each unit. The Biology textbook does not fully promote the goals of “key transferable skills”. These include, critical thinking, analytical skills, problem solving, interpersonal relations, communication skills, numeracy skills, information skills, self-management, competitive skills, study skills and creative skills.

#### **4.2.5 The question and test papers**

As indicated earlier in Table 4.1A and 4.1B, the Grade 11 and 12 Biology learners write three compulsory exam papers at all levels. In preparation for the exams, learners do write tests. It was thus, necessary for me to analyse some exam and test papers to gain insight on how EL is assessed through the tests and how it is examined.

It was clear from my analysis that in terms of assessment objectives, all papers were consistent with the syllabus requirements. Paper 1 higher level, Paper 2 ordinary level and Paper 2 higher level Section A had a similar orientation. In these papers most questions start with a diagram. For example, Paper 2 ordinary level has structures of the plant cell, human digestive system, neurons, heart, and plant leaf. Paper 1 higher level has structures of the insect pollinated flower and female reproductive system. Section A, Paper 2 higher level has structures of the heart and kidney (in all 3 papers there were more structures than mentioned). Most questions in these papers require learners to label and give functions of certain parts of the diagrams, which made up the majority of the questions to be assessing objective A, but there are also a fair number of questions testing assessment objective B of the syllabus and a few assessment objective C questions.

The analysed Paper 3 for both levels clearly gave learners a sequence of instructions (in the case of higher level, appropriate techniques to demonstrate and carry out practicals were provided) (see Appendix 10). The questions expect learners to make recordings, estimates, observations, accurate measurements and apply their scientific knowledge and understanding to make interpretations and to draw appropriate conclusions from practical observations and data. Both levels specifically covered questions on biological drawings, calculation of magnification, plotting of graphs and testing a leaf for starch/ food tests. However, my analyses did not include ordinary level Paper 1 (multiple choice paper), because there was no specimen sample paper provided for this paper. This paper usually tests abilities in assessment objectives A and B.

In terms of EL coverage, EL coverage in the examination papers is less. For ordinary level in Paper 2, there are questions on the use of fertilizers and pesticides to increase crop yields and how the use of pesticides may lead to serious environmental damage and a few questions on HIV/AIDS. Paper 1 higher level has a few questions on adaptation of arthropods to their habitats and the risks of Malaria. Paper 2 higher level seems to cover a bit more of EL but most of the questions are in section B. This section has 4 essay questions and learners are only supposed to

answer 2. EL topics covered in Section B are on the importance of temperature to mammals, hormonal effects on plant growth, description of an energy flow through ecosystem and discussion on the possible consequences of land clearance. But Section A also covers a few questions on how the photosynthesis rate can be affected by light intensity and high temperatures and the effect of different conditions on plant growth. For Paper 3 both levels did not explicitly cover EL topics.

### 4.3 TEACHERS' VIEWS ON EL

The interviews cover a range of aspects of how EL content is covered in the syllabus, what teaching strategies the teachers use to present EL topics, what influences their implementation and what enables and constrains the implementation of EL. The results from interviews are presented in the section below, and discussed in relation to other data sources in Chapter 5.

#### 4.3.1 Teachers' profiles

As a starting point for the interviews, the profiles of the six teachers who participated were compiled during the individual semi-structured interviews to gain insights into teachers' qualifications and teaching experience (see Table 4.2 below).

**Table 4.2 Composition of teachers' qualifications and teaching experience**

School	Teacher	Qualification	Years of teaching experience	Years of teaching Biology
W	P1	B.ED (Biology and Economics)	2	2
W	P2	B.ED (Biology and Mathematics)	7	3
X	T1	B.ED (Biology and Mathematics)	4	4
X	T2	B.ED (Science)	4	2
Y	T3	B.ED (Biology and Mathematics)	7	7
Y	T4	B.ED (Biology and Geography)	4	1

Table 4.2 shows that all 6 teachers who participated in this study have a Bachelor degree in Education, with Biology as one of their majors. Their general years of teaching experience range between 2 and 7 years, their years of teaching Biology range between 1 and 7 years. It is also worth noting that P2 is head of department of Science at school W.

#### **4.3.2 Teachers' views on EL in the Biology syllabus**

All the interviewed teachers indicated that EL is about topics that are related to the environment and they indicated that the Biology syllabus does cover EL topics. They all indicated that they do have experience in teaching EL because they have taught Biology before. Environment is, however, a broad concept (P1 and T4).

**Teacher P1:** Defined EL as *“EL is about teaching and learning the ecological aspects of the environment, it is about taking care of the environment and its issues in Biology this includes topics like food chains and pollution”*. She indicated that EL coverage in the syllabus is not substantial, and it mainly involves teaching concepts with little detail. She gave the following example, *“for example the syllabus requires definition of global warming but no details on how global warming affects the environment and organisms, very often you only teach terminologies and not massive amounts of information or impacts”*.

Group discussions and asking learners to find information prior to the lesson are her usual ways of teaching EL. She finds asking learners to find information prior to the lesson effective as learners usually find more information than the syllabus requires. P1 sees this as part of learner-centred approach. She, however, indicated that because covering the entire syllabus topic was very important for her teaching, she hardly uses any additional materials other than the textbook, scheme of work, chalkboard, weekly lesson plans and transparencies to present her lessons on EL. But if necessary she uses other Biology books to make copies of any relevant information not adequately covered in the textbook.

**Teacher P2:** Estimated EL content in the syllabus to be about 5%. He said EL issues are cross cutting and well captured in different subjects. His first priority is also to cover the Biology syllabus, and he indicated that, *“... apart from the syllabus, I am guided by my instincts thinking this is right and this is wrong”*. But he said, he sometimes adds relevant information that is not necessarily required by the syllabus. His preferred method of teaching EL is class discussions as he said, *“Currently teaching EL in the classroom is a matter of discussions in class, learners bringing in their backgrounds or the information that they pick up here and there, be it from videos they see or television and that perhaps becomes the central point of discussion to expand or to build on”*.

His teaching of environmental topics is not limited to one textbook. He uses a variety of textbooks, because he believes that there is no book that is good enough, it just depends on the topic. Although P2 thought there was not enough EL in the Biology syllabus, he indicated that it is not necessary to add more EL content, learners with an interest in EL can continue with it at tertiary level. Apart from the syllabus and internal assessment policy, the type of learners he has and his love for nature influences his teaching of environmental topics.

**Teacher 1:** Defined EL as follows:

*I think EL for me is when I expose my learners to the issues of the natural environment as well as exposing them to environmental issues in their surrounding and synthesising them on how their daily activities/decisions could impact on their environment. EL is also a platform for me to educate my learners on how to respect the environment/take care, for the benefit of the future generation. So, it is about generating interest regarding environmental stuffs in the classroom (and through outdoor activities) and advocating - so that they can be custodians of their environment. Examples of such topics in the Biology syllabus are food chains, conservation and pollution.*

T1 estimated 20% of the syllabus to be EL and indicated that there are no details, she said that, “for instance it says transpiration is this and the plants do this and that, but there are a lot of things that they are not touching that relates to transpiration at the learners level”. Her priority is also to cover the Biology syllabus as she indicated that, “... that is why in as much as you want to teach, you are trying to cover the objectives of the syllabus on EL”. Her main method of teaching EL is by exposing learners, for example if she is teaching about certain types of plants they have at school, she expose learners to them. The textbooks and chalkboard are her main teaching aids for EL, but she sometimes uses the examiners reports to teach EL concepts. She said she does not have a teachers’ guide, but she remembered using it over the years and it lacks detail, thus she ended by saying, “I would rather go to the internet, look up for certain projects that I can carry out, rather than that guide itself”

**Teacher 2:** Estimated that approximately 15% of the syllabus is EL and suggested more EL should be added because according to him EL is not enough because, “even the part of the environment that is mainly in Biology it is mainly pollution I would say, population and just a bit of ecosystem, so it’s still little according to my opinion”. He added that, “Biology syllabus is more of human Biology than EL, if they can make it 50/50 it could be better, we need to know

*much of the environment because the environment plays a role in our lives". He generally follows the syllabus and the textbooks. His main method of presenting EL is class based but he uses other methods such as research projects and investigations. He seldom uses teaching materials other than the textbook as he said it is all he has. He has no other curriculum policies except the syllabus.*

**Teacher 3:** T3 defined EL as follows:

*EL is about the need to take care of the environment where we live, perhaps looking at the species, how to conserve these species whether plants or animals, thus, how we take care of the environment for the benefit of ourselves and the benefit of other organisms that live in the environment.*

She further answered that,

*I have been teaching Biology for 7 years and I have been exposed to those topics of EL, specifically the last topics in the syllabus, topics for instance like the relationship of organisms with one another and how they interact within the environment which is more about food chains and food webs, how certain organisms live in certain environments and interact with other organisms, population, nutrient cycles, pollution and conservation of species within the environment.*

T3 then estimated EL to be 75% coverage in the syllabus by adding that,

*Perhaps it's just because I am not exposed to what EL is about, that is why I say in my personal view, since the Biology syllabus is about the environment, the people, the species that are found in the environment, so even though I don't know what EL is about, I would suggest that all these topics cover the environment, the energy flow, even if you are talking about food and nutrition for instance, all this are part of the environment.*

T3 said her first priority is also to cover the syllabus as she pointed out that, *"I make sure that, I cover all the objectives that are covered in the syllabus, because that is what we are required to do. I use these policy documents when I am doing my lesson preparations everyday"*.

Her main teaching aids are the chalkboard and textbooks but she uses posters sometimes. She states that she uses learner-centred methods, and she prefers exposing learners, for instance when teaching topics related to pollution of land and pollution of water, so that learners get to see and visualize by looking at the reality of these topics.

**Teacher 4:** Pointed out that EL is about how living organisms interact with the non-living things in the environment and the impacts they have on the environment. He added that,

*When it comes to environmental topics, that is quite broad, because environment is a broad concept and it is linked to many topics, so we can talk about for example how plants adapt to the environment or even start with the photosynthesis process itself..I think more of the syllabus topics related to the environment is on plant adaptation, the rest of the topics that I have covered are not related to the environment.*

T4 added that the Biology syllabus focuses more on structures of living organisms, he then estimated EL content to be 20% in the syllabus and suggests more EL should be added by saying,

*I think they should increase the EL topics. We need to look at the sustainability of the environment, human activities and the impacts of human activities on the environment, we can even start with the animals the way they are grazing, we do have overgrazing that is caused by animals, we do have deforestation caused by human activities and pollution caused by human activities, and therefore I say if we could make EL more, it will broaden the knowledge of teachers and learners on how to take care of the environment.*

His priority is also to cover the Biology syllabus. His teaching approaches vary from learner-centred to teacher-centred approaches depending on availability of resources and the EL topic being presented. He, however, likes using posters, models, and group discussions and learners' presentations for teaching EL. He said learners' presentations and observations are the best way to present EL because learners learn better when they listen to each other. He has the assessment policy documents that inform his assessment criteria and the internal Biology policy which is drawn up from the national policy of Natural Sciences. Together with the learner-centred policy they all inform his teaching. He has a teachers' guide but said it lacks details, thus he does not find it effective.

#### **4.3.3 Teachers views on teaching methods of EL in the Biology curriculum**

Teachers said they use a variety of teaching methods to teach EL. They all indicated that they engage learners in the EL lessons by giving research projects, investigations, and topic-based presentations, making models, and group discussions. T1 specifically said, "*I usually ask a lot of questions and I like them to think as to why, for example, if I tell them, look at the plants this time*

*around they do not have leaves, I should ask them why... ”. P2, T1, T2, T3 and T4 explained that they have diverse learners in their classes thus when teaching, they try to be as general as possible. However, they revealed that diversity and culture plays a great role when it comes to EL, hence they like having a class combined with people from different areas and cultures. Their areas are used as teaching examples. It makes learning more interesting as learners give examples that relate to their own experiences and opinions based on what they do in their different communities and cultures.*

*Using learners’ experiences in the discussions on EL, boils down to learner-centred education, the learners have ideas, it’s not like they don’t know what is going out in nature, if one have to look at EL... they can also learn from each other as they come from various parts of the country. Example a learner coming from Katima (the north) will learn a thing or two from a learner coming from Karas (down south), for example, up north they have rivers, the hippos and crocodiles while in the Karas, they have other things that they do not necessarily have up north (P2).*

While T3 said:

*For instance, when it come to examples of topics like, food supply, or the use of modern technology, example what type of modern technology they use to increase food productions, do they use tractors, do they use old modern ways of ploughing, learners become interested, that if some use tractors, what do others use in their cultures and communities.*

All teachers, however, said they like to use examples of what learners are familiar with or what they will be able to relate to when teaching.

*I consider what we have available at school, if I know that we have this tree and it responds this way because of that then that’s the first thing I will consider, but if I know that I don’t have access to what I need at school, I think about other things or can give examples based on the things that I think learners will be able to get hold of (T1).*

*I like to go for local... for instance I cannot give an example of the Namib desert when learners do not know what the Namib desert is like... that is why they say we should use our natural environment as a proper example in our teaching because if for example you are telling the learners about proper housing and they have never seen a proper house, it will be difficult for them to understand... I give examples of things that learners are familiar with (T4).*

And T3 said “... *examples of things the learners know if I find that what I am teaching is new for the learners than I draw certain pictures to show to them, just to make my discussion clearly understood. Thus, how I will choose my examples and illustrations depends on the learners*”.

However, all teachers, except T3 revealed that they do encounter problems when engaging learners in the EL lessons. P1, P2 and T2 point out that (some) learners do not do the work, do not participate, do not do the homework, and do not listen. T2 further mentioned that, “*Learners don’t see themselves as part of teaching and learning*”. T4 said the main problem he encounters when engaging learners in EL is lack of knowledge among learners. He explained that, “*If you ask the learners the impact of the pesticides, most of the learners will not have an idea what the effects of pesticides are on the environment, or the quality of water, how it affects the aquatic organisms*”.

All teachers recognized the importance of the assessment method as a way of testing learners’ understanding of EL. They indicated that they use various assessment methods as indicated in Table 4.3 below.

**Table 4.3 Summary of assessment methods used by teachers**

<b>Teacher</b>	<b>Assessment types</b>
P1	Tests, class work, worksheets, projects
P2	Tests, worksheets, orally asking questions when teaching, homework
T1	Tests, class work, homework , projects
T2	Research projects, tests, investigations
T3	Research projects, class work, tests, homework
T4	Class work, topic-based tests, orally by asking questions when teaching

Table 4.3 shows that the main assessment methods used are tests, class work and projects but giving homework and worksheets are also common. In terms of assessment teachers said they are continuously assessing learners because they are advocating assessment *for* learning and not necessarily assessment *of* learning. P2 explained that, when you assess for learning, you use assessment as a tool to aid the learning process by not only assessing what the learners have learned but what they did not learn. Assessment for learning gives one a chance to see what learners have learned and what needs to be built on for them to know something.

In terms of exams, teachers indicated that there is usually less EL examined. P2 and T4 estimated that only 5% of the total exam marks are EL. They explained that, sometimes EL does not even exist in the exam papers and it just depends on examiners. For ordinary level, at times EL is only in the multiple choice paper (Paper 1) and sometimes only in Paper 2, but rarely in Paper 3 (the practical paper).

*Experiment wise, none of the higher level exams have ever done any experiments on EL topics; maybe the set up of the EL topics in the syllabus does not allow experiments to be carried out. But there are good topics that can be carried out maybe just finding out how acid rain is formed, or on pollution and how one can eliminate that (T2).*

T2 added that the little EL covered in the examination influences his implementation of EL by stating that, *“I would say the EL topics are actually not having much impact on learners learning because of how the set up is, EL is the last one in the syllabus, is very few, many learners don’t have interest on environmental issues, so all that influence the implementation”*.

T3 said the exams only cover about 25% of EL topics.

Some teachers, however, mentioned that assessing learners helps them reflect, to see what has been covered and achieved. Reflecting on the lessons helps them reinforce teaching where necessary (P2, T4, T1). But related to reflections T3 said she only reflects sometimes, because *“I have too many subjects to teach, I teach 39 periods out of 40 periods, thus do not get enough time to do reflections for all subjects because of the workload”*. She explained that it is necessary to do reflections because it allows you to go through the syllabus to look at what has been covered and to improve the pace of teaching.

All teachers indicated that there are some methods they would like to use to teach EL but there are constraints. P1 said she would like to carry out more practicals with the learners, T3 said she wants more visualization for EL and like T1, T2, P2 she said she would like to use videos/video clips to teach EL. For example P2 said,

*If I were to look at Biology environmental topics one would perhaps like to show them what they show on Sunday afternoons on NBC on the Kruger National Park, how they move the animals or how they take care of the wounded animals and perhaps the interactions between animals, the lions how they live within the park, the hyenas and the feeding relations that are there. If one could have those topic based videos perhaps it*

*could add value to what we are doing because one can perhaps give them the videos to watch and let them write an activity having observed what is happening, at least that brings the park into the classroom, if you cannot take the learners to the park then one needs to bring the park into the classroom.*

T3 shared a similar sentiment by saying,

*I will prefer to use video clips to expose learners to the issues of the environment, so that they are at least aware. Issues for instance like pollution of land, you find children urinating around, without considering the effects this might cause to them, or you find children throwing papers around without considering what will happen afterwards, that shows that children are not aware of such issues in the environment.*

#### **4.3.4 Teachers' views on enabling and constraining factors influencing EL implementation**

The teachers were asked what type of support they receive from different stakeholders and schools to help with their implementation of EL. Table 4.4 below gives the summary of the teachers' responses regarding the support received.

**Table 4.4 Summary of support given for effective implementation of EL in Biology**

<b>Teacher</b>	<b>Workshop</b>	<b>Advisory teachers</b>	<b>Management</b>	<b>Other teachers</b>	<b>Parents/ community</b>	<b>Cluster system</b>
P1	Once	Never	Supportive	Not supportive	Not involved	Not effective
P2	Once	Not much	No comment	Supportive	Few involved	Not effective
T1	Never	Never	HOD class visits	Supportive	Some parents	No comment
T2	Never	Not at all	HOD class visits	Supportive	Not involved	Not helpful
T3	Never	Never	HOD class visits	Not supportive	Few involved	Not effective
T4	Never	Never	HOD supportive	Supportive	Not involved	No comment

#### 4.3.4.1 Support

Table 4.4 above shows support rendered from different stakeholders, workshops and other schools for effective implementation of EL. Teachers had different opinions. Regarding workshops P1, P2 and T1 said they have only attended one workshop in Biology and that was earlier this year. The workshop was looking at how practical activities can be done in Biology. They acknowledged that the workshop was informative and the schools received resources that could be used for practicals but this was not directly environmentally related. P1 and T1 added that, even though they received information on how to carry out certain practicals, they will not be able to carry them out because of technicalities at school such as lack of resources, class sizes and lack of time. T3 and T2 said they have never attended any Biology workshops throughout their years of teaching.

In terms of support from the management, T1, T2, said they do receive regular class visits from the HOD. But they said they do not find the visits effective because the HOD does not have the subject knowledge (he is a Physical Science and Mathematics teacher), his visits are not subject related, they are looking more at administration files. T3 said the school management is not supportive, she also receives class visits from the HOD but these are not effective. She said the class visits are usually conducted at the end of the term when she is doing revision and she does not get feedback on what was observed during the class visits to reflect on and to evaluate herself. P1 and T4 said their HOD is helpful. T3 stated that a negative relationship between teachers and the management has a negative impact on both teacher and learners' performance.

Teachers were asked whether they receive any visits or support from advisory teachers that help them implement EL. Here are some of their responses: T2 said, *“Advisory teachers never visited since I came to this school, for 4 years now. I think their visit will actually make a difference, not necessarily seeing what is happening in class but to be told that what you have witnessed is what we go through due to lack of A, B, C, D...”* T3 simply said, *“I do not even know what advisory teachers are”*. She, however, went on to explain that, *“...I think the advisory teacher is an expert in that particular subject, for instance if I have problems in my subject...”* And T1 said, *“Actually not, never ever since I started teaching”*. P2 said apart from the workshops that advisory teachers organize, he thinks they can do more and there is still room for improvement on their part. He added that:

*I think the only communication that is most of the time there is when there is policy change, and it comes on paper telling you this is the way you calculate your CASS marks or this is how the format of question paper ought to be. Physically they are hardly in the schools, myself for being in a school for 7 years, I do not recall a day that an advisory teacher visited me to observe my lesson regardless of the subject so that leaves a lot to be desired. I think they should play a more active role, were they should come to schools, and not to police but to guide were teachers go wrong...*

P2, T1, T3 acknowledges the little support they receive from a few parents and community members.

*Parents can do a lot more, others are very much reluctant in paying school development fund of their children, and it's this funds that the school can use to acquire things like to build laboratory facilities, government is taking forever to do that, or perhaps acquiring vehicles for the school to transport learners easily compared to hiring transport and perhaps video clips would be purchased if the funds were enough and more textbooks all for the benefit of the learner academically (P2).*

But P1, T2, and T4 said the parents and community members are not keen to help them. For example T2 said, "... they are not involved, that is a serious problem in education, parents withdraw from caring, they should know the importance of education. I recommend that they should get involved; education is from 3 angles, parents, teacher and learner". Except for P1 and T3, all the other teachers indicated that other teachers at school are supportive in implementation of EL. For example T1 said, "Sometimes you just ask your colleagues, sometimes you have the material but you still don't understand the work...". While T4 said, "... if I know that I will not be able to teach a certain EL topic, I will consult the experts from school or I will try to seek for assistance on how to present that part". And P2 said,

*At school level, in the department, Mathematics and Science, there is an understanding that we share knowledge, we share the little that we have in terms of expertise and experience and that builds team work and that also helps learners in general. We even go to the extent of asking a colleague to teach a topic or to explain an aspect that we are not comfortable with to the extent of changing classes for a lesson or two should one be competent in an aspect that you are not competent in.*

Most teachers said that other schools are not supportive and the cluster system is not effective. Except for P2 who said that schools around them are helpful. He explained that they do not have

a Biology lab for practicals. Higher level learners write practical exams, thus, during the exams their neighbouring schools assist them by accommodating their higher level learners for practical exams. In terms of equipment that they do not have, they borrow from other schools. He, however, added that,

*In Namibia we have a cluster system, I think cluster schools can do more, currently the schools that I mentioned that are supporting us are not necessarily the schools in our cluster system, I think at cluster level we can do more, for instance share resources and expertise at cluster level. That will only add value to our work, but for whatever reason our cluster system is not efficient in that regard.*

T1 and T3, however, also pointed out that they usually do not have subject meetings, only departmental meetings once a trimester or sometimes once a year. They emphasized that, the departmental meetings do not help them implement EL because they are mostly about administration issues, such as how to set examination papers, files, moderation of papers and mark sheets: they are never subject content related.

Teachers also named a lot of enablers and constraints that influence their implementation of EL. Table 4.5 below provides a summary of the named enabling and constraining factors of EL implementation.

**Table 4.5 Summary of teachers' views of enabling and constraint factors of EL implementation**

<b>Teacher</b>	<b>Constraints /enabling</b>
P1	Resources, class size, time, textbooks, learners' interest and discipline, experience
P2	Time, vastness of the topics, no field trips, lack of transport, resources, internet, teacher's interest, cross cutting, handouts, class size, textbooks, cost implications, policies
T1	Learners' discipline and interest, time, textbooks, resources, internet, teacher interest and experience, examination reports, lack of transport.
T2	No field trips, textbooks, limited resources, learners' lack of interest, internet, handouts, limited EL topics in the syllabus, time
T3	Lack of exposure, resources, teacher's interest and experience, cross cutting, policies
T4	Lack of knowledge, class size, textbooks, cross curricular, lack of resources, handouts, lack of exposure, internet,

#### **4.3.4.2 Resources and textbooks**

One can deduce from the responses from teachers (Table 4.5) that lack of resources is a key constraint to effective implementation of EL. All teachers indicated that generally resources to teach EL are not sufficient. For example P2 stated that, “... *I think we can still improve, for example we do not have a fully fledged lab at school, we do not have models, and those are things that we can work on to improve as an institution perhaps to better deliver services*”.

All teachers indicated that learners have NAMCOL modules (the textbooks) that they use for Biology. But T2 said his learners do not have all modules, some for example have Module 1 and 2 and not 3 and some have Module 1 and 3 and not 2. The modules have a few mistakes but are effective because they cover the Biology syllabus content (P1, T1, and T3). In addition to the modules, P2 and T4 mentioned that their learners also have a second Biology textbook, by McKean and the textbook for Southern Africa. T3 and T4 mentioned that there is lack of visualization on EL topics. They said sometimes when teaching topics such as the processes involved in sewage treatment (mentioning the aeration tank and sludge), that it would be beneficial if the learners were exposed to these processes at a practical level, in order to study how they worked. They reasoned that this would assist learners in the examination, if they forgot the explanation, at least they would be able to remember what happened in the process. T3 added that, “... *learning does not only take place by interaction or by the constructivism approach but also by observing what is happening in the real world*”.

#### **4.3.4.3 Fieldtrips**

One other important component constraining the effective implementation of EL in Biology is field trips that do not exist. T2 clearly explained that EL is not supposed to be a class-based component, but that it is the practical part of the syllabus that they are putting into theory. He said EL is best taught with field experience. Students learn best with real life experience, thus he added, “*I suggest there should be planned field trips on the school calendar where learners would go and visit certain areas just to compare the vegetation of different areas or just to see how organisms adapt in their areas, which are actually not happening*”. All teachers, however, indicated that the main constraint on fieldtrips is transport, costs and arrangements at the schools.

*... as far as EL is concerned, perhaps one could take them out of class and take them to a small ecosystem, for example a pond. I am looking into the possibility should I be teaching Biology next year or even this year already, of taking them to the Gammams wastewater treatment plant, look at water recycling and everything that goes into it, I am also looking at the possibility of taking them to the Goreangab dam where they will look at the ecosystems around the dam, we can have a discussion around that area, hopefully that will also promote interest within some learners even to go into environmental studies or conservation studies beyond Grade 12(P2).*

#### **4.3.4.4 Teachers' knowledge and experience**

All teachers indicated that they are fairly knowledgeable when it comes to EL and have no doubts when teaching EL. They mentioned that they gained their EL knowledge through experience and through studies. P1 and T1 said the experience they have makes them become better prepared in terms of teaching strategies, materials to use, assessment methods and it also makes them more comfortable teaching environmental topics. T3 estimated her EL knowledge to be 60% by stating that,

*... I have experienced myself in my teaching, what I have studied at the university because I have studied Biology, even though we did not really specialize in environmental learning, so I think being a Biology teacher or Biology educator, I have covered 60% of EL even though I would really not know what EL is, because I didn't study that.*

T4 estimated his EL knowledge to be 70% and added that,

*To me teaching EL in Biology is an advantage because I am a Science and humanity teacher, so if you look at the environment its more linked to humanity, I teach Development Studies, which focus more on environmental issues, it is an advantage to me, that's why I say I don't really experience any problems when it comes to those topics, I am more exposed when it comes to EL.*

While P2 said, *"I think I am fairly exposed in terms of knowledge in the area, even though time can never allow me to cover all there is to cover"*. And T1 said,

*I think I m quite good with EL, it is actually one of those Biology areas that I enjoy. It's like you are talking about something that you know that is happening, is not like talking about enzymes and they cannot see an enzyme there, the moment you start talking about*

*plants, yes they can see plants and this what they have and this is what they are doing. I consider myself to have a quite good understanding on EL.*

#### **4.3.4.5 Time and time management**

Most teachers said time allocated for Biology which encompasses EL is not enough. They indicated that they do not have double periods on the timetable which are supposed to be used for practicals and carrying out certain projects with the learners. P1 and P2 said there are too many disturbances on the school calendar, for example learners often go for career exhibitions or plays at the theatre for English and all those compromise the teaching time.

*For instance, if you have to send out learners, to go out of the school premises and look for this and that to construct a food chain, they have to go out and for instance look for grass, look for locusts, that require time, so our 40 minutes period is so insufficient. No double periods and that is the serious concern that we have been raising, because there are times that you need more than 40 minutes but can't, you just have to do them after school (T2).*

And P2 explained that,

*Time is never on the side of the teacher, when discussions are getting interesting, one does not really explore all the avenues as far as the ideas coming from the learners are concerned because of time constraints, because you are given this much work to cover in a particular time frame, and that also limits the implementation of these topics.*

Work not covered in the lesson due to lack of time, is given to learners as homework or work assignments. Sometimes they arrange afternoon sessions to finish of the tasks, but that is a serious concern as learners do not turn up in numbers in the afternoons (P2, T1 and T4).

#### **4.3.4.6 Learner participation and motivation**

P1 and T2 mentioned that one of the factors constraining EL implementations is learners' discipline and lack of interest in EL. P1 said, "Grade 11 learners do not care about school work, they know its automatic promotion to Grade 12". And P2 said,

*There are learners that are in school because they know why they are at school; they are purpose driven as far as their school work is concerned...then you have other learners that do not dream at all, they are just at school because they are told to be at school or because everyone else is at school...*

But, T3 said learners love interacting with each other, and show interest in EL.

#### **4.3.4.7 Teachers' interest and experience**

P2, T1 and T3 indicated that the interest they have for EL enables them to teach EL.

*My love for nature that I developed over time and of course during my studies when I took ecosystem ecology and subjects related to the environment. Indeed the reason why I am a Biology teacher today is because of the love that I had for environmental Biology that influences it a lot (P2).*

While T3 said, “because of my interest, EL is very interesting, example population, the cycles, energy flow and conservation”. P1, T1 and T3 indicated that experience makes it easier. For example T1 said, “Experience makes it easier, because you already know what and how to teach and what projects to give to the learners with different EL topics and already have lesson plan in place, teaching same things over and over again, it becomes easier”.

#### **4.3.4.8 Projects and programmes**

Teachers were, however, asked if there are any extramural activities or projects at school that help them implement EL. All teachers indicated that there are no projects at schools that help them implement EL. T1 said they only do cleaning campaigns sometimes and it help learners understand why it is done. T3 said,

*We do not have environmental projects, I suggested a science club, perhaps it was going to be an opportunity for the learners to interact with one another, discuss certain topics... but it did not materialize, because of the management of the school, they are the decision makers of everything in the school.*

#### **4.3.4.9 Integration**

P2, T3 and T4 indicated that EL is taught across the curriculum, which makes it easy to implement it. For example P2 said, “EL topics are taught across the curriculum, EL are well captured under different subjects that we have for example in Geography, Economics and that only makes it easy for the teacher because some aspects are already taught in Geography to make them answer questions in Biology”. He, however, also stated that EL is integrated in the curriculum documents by stating that,

*But in general the national curriculum for schools policy, subject policy all subject guide all those are somehow informing my practice on how I should implement this, the major areas they give there is “creating responsible citizens, having learners that are taking care or that are aware of their environment and takes care of their environment for their own current generation and generation to come. It boils down to learner-centred education” I think those are the core guiding principles that I captured from the various documents that are there.*

Sharing a similar sentiment is T3 who said, “Some of this topics like population is also part of Geography, learners come in with knowledge from Grade 8 already in subjects like Life Science and Geography”. She also added that EL is integrated in the policy documents by responding that, “These are all topics stated in the syllabus, the syllabus is one of the policies I use, the teacher’s guide, the scheme of work, this are all policies and contain EL”.

#### **4.3.4.10 Class size**

P1, P2 and T4 explained that class size is a constraint to effective EL implementation. They indicated that some classes have 41 to 46 learners. They said even if they put learners in groups, the groups are big and a 40 minute lesson is not enough to monitor every group. T4 added that, “That’s why I am saying yes learner centred should be applied... but if it really fits...”. But T1 said her classes have about 36 learners which are manageable.

### **4.4 TEACHING PRACTICES**

This section will present data of what was observed in the different EL lessons. The data includes the methods used by the teachers to present EL as well as other aspects that helped me answer the research questions. As stated in the methodology chapter, 18 lessons were observed for this study and they are coded LO1 to LO18. However, because some teachers in some lessons did not have lesson plans, most of the data will be from lessons that had lesson plans as it was easy to observe and follow the lessons (LO3, LO4, LO13, and LO8-11) (see Appendix 7). Furthermore, as indicated in the methodology chapter some lessons observed were not directly EL related, thus I will not use them in my examples. The lessons have been numbered according to teachers not necessarily according to when observed.

#### 4.4.1 Written teaching preparations

Only in LO3, LO4, LO8, LO9, LO10, LO11 and LO13 (see Appendix 7) did teachers have lesson plans. The written lesson plans followed standard forms for lesson planning designed for each school. Some lesson plans were incomplete for example T2 lesson plans did not indicate the basic competencies, introduction, consolidation and evaluation. P2 indicates that there is no assessment, no monitoring of homework and no consolidation. T3's lesson plan has no teaching and learning aids and learning objectives. In lessons where teachers did not have lesson plans it was difficult for me to follow the lessons. The different teachers planned different lessons based on the syllabus topics and lesson objectives. Topics covered are shown in Table 4.6 below. The detailed lesson objectives are shown in Table 4.7.

**Table 4.6 Number of lessons and topics observed from different teachers**

Teacher	P1	P2	T1	T2	T3	T4
Lessons	LO1-LO2	LO3-LO4	LO5-LO7	LO8-LO11	LO12-LO15	LO16-LO18
Topics observed	Transport in plants	Conservation	Excretion	Artificial selection, food chains and food webs	Conservation	Food preservation and alimentary canal

Table 4.7 below provides an extract from the syllabus to show how the topics, the general objectives and learning objectives to be achieved are represented. Take note: Higher level Biology learners usually have extra learning objectives to cover than ordinary level learners, thus in Table 4.7 all specific objectives that have (\*) next to them are only to be covered by learners who are taking Biology on higher level.

**Table 4.7 A sample of learning objectives in the higher level and ordinary level syllabus**

TOPIC	GENERAL OBJECTIVE learner will:	SPECIFIC OBJECTIVES Learners should be able to:
4.2 Conservation (P2, T3)	Consider the need for conservation of species, their habitats and natural resources	<ul style="list-style-type: none"> <li>• define conservation as maintaining the environment and natural resources in a state that maintains biodiversity</li> <li>• describe the need for conservation of species and their habitats and of natural resources</li> <li>• discuss the advantages and disadvantages of tourism for conservation</li> <li>• describe the principle of recycling of materials, e.g. water (sewage), paper (trees), plastics and glass</li> <li>• describe one conservation project, either of local or of international importance, and discuss the problems in implementing it and its degree of success</li> </ul>
4.5 Artificial selection (T2)		<ul style="list-style-type: none"> <li>•* Discuss the development of antibiotic resistance in bacteria</li> <li>• describe the role of artificial selection in the production of varieties of animals and plants with increased economic importance</li> <li>•* discuss the importance of maintaining gene banks and rare breeds</li> </ul>
6.3.1 Food preservation and alimentary canal (T4)	Know the structures and functions of the human alimentary canal	<ul style="list-style-type: none"> <li>• discuss the uses, benefits and health hazards associated with food additives, including colouring</li> <li>• describe and identify the gross structures of the alimentary canal</li> <li>• define ingestion, digestion, absorption, assimilation and egestion</li> <li>• describe the functions of the alimentary canal's various parts in relation to ingestion, digestion, absorption, assimilation and egestion of food</li> </ul>
7.1 Transport in plants (P1)	Know water uptake, transpiration and translocation in plants and understand the importance of these processes for plants	<ul style="list-style-type: none"> <li>• identify and describe the structure of a dicotyledonous root and stem</li> <li>• describe the uptake of water by osmosis</li> <li>• describe the pathway by which water enters a plant, crosses the root, moves up through the xylem vessels, enters the leaf cells and leaves the plant leaf through the stomata</li> <li>• describe the mechanisms through which water moves from roots to the air, in terms of water potential gradients</li> <li>•* describe the structure of the xylem vessels and relate to their functions of transport and support</li> <li>• describe transpiration and explain how environmental conditions (temperature, wind speed, humidity and light intensity) affect the rate water vapour diffuses out of the stomata and hence affects the rate of water uptake</li> <li>• describe how wilting occurs</li> <li>• describe the ways in which plants that are xerophytes can reduce water loss, with reference to two locally occurring examples (e.g. <i>Aloe</i>, <i>Euphorbia</i>, Quiver tree)</li> <li>• define translocation of the movement of sucrose and amino acids from regions of production to region of utilisation of respiration or growth</li> <li>• describe the translocation of applied systematic pesticides in phloem throughout the plant</li> </ul>

		<ul style="list-style-type: none"> <li>• *describe the structure of phloem sieve tubes and companion cells and relate this to the translocation of sugars and amino acids.</li> </ul>
10. Excretion in humans (T1)	Acknowledge the necessity to remove toxic waste products of metabolisms	<ul style="list-style-type: none"> <li>• define excretion</li> <li>• *explain that deamination of amino acids in the liver produces urea</li> <li>• describe the breaking down of alcohol, drugs and hormones in the liver</li> <li>• describe the relative position of the kidney, ureter, bladder and urethra</li> <li>• describe internal structure of the kidney</li> <li>• describe the function of the kidney</li> <li>• *describe function and structure of nephron</li> <li>• *list mayor constitutes of urine and explain how urine is produced by nephrons</li> <li>• explain dialysis and discuss application in kidney machines</li> </ul>
1. Energy flow, food chains and food webs (T2)	Understand flow of energy through the ecosystem	<ul style="list-style-type: none"> <li>• explain the sun as the principal source of energy inputs to biological systems</li> <li>• * explain that sunlight energy is transferred to chemical energy during photosynthesis</li> <li>• describe the non-cyclical nature of energy flow through the ecosystem</li> <li>• explain the meaning of the following terms: food chain, food web, producer, consumer, herbivore, carnivore, decomposer, trophic level and ecosystem (using local examples)</li> <li>• explain food webs in terms of energy flow</li> <li>• describe energy losses in a food chain and relate this to the length of the food chain</li> <li>• *interpret data showing energy flow between trophic levels in an ecosystem and calculate efficiencies of energy transfer</li> <li>• describe and interpret pyramids of biomass, numbers and energy</li> <li>• explain that there is an increased efficiency in supplying green plants as human food and that there is a relative efficiency, in terms of energy loss, of feeding crops to animals.</li> </ul>

(Source: Namibia. MoE, 2005)

The topics indicated in the tables above represent the topic and learning objectives taught by the different teachers during observation (for P1 who taught transport in plants not all learning objectives were observed). It was observed that teachers do follow the Biology topics sequentially.

#### 4.4.2. Teaching strategies observed

Some of the teaching strategies observed are as follows:

### **Teaching strategy 1: Use of learners' prior knowledge**

The lessons observed did not really show how the teachers used the learners' prior knowledge, although there were some instances in the lessons where teachers drew on their knowledge. For example in LO16 the teacher asked, “*How many of you are allergic to some type of food such as, as mushrooms, canned fish or any other ...*” this led to T4 explaining how food additives can cause allergic reactions. In the same lesson, T4 also asked the learners how they preserve food at home as a way of introducing food preservatives.

### **Teaching strategy 2: Use of local examples**

Use of local examples was one of the strategies used by all teachers when explaining and clarifying things to the learners. However, these examples did not really spark off discussions during the lessons. In LO2 the teacher said, “*... use examples such as bees, butterflies, mosquitoes to explain the process...*” in the same lesson when P1 started explaining translocation she started by saying: “*the moment I talk about translocation, I think of pesticides because we all know what pesticides are...*” In LO10, the teacher used known animals and plants by, for example, drawing the following food chains on the chalkboard “*Grass – locust – scorpion – baboon*” and other local examples such as lions, grass, cheetahs, cow, tick, Mopani worms, Mopani trees, maize plants to draw and explain food chains and food webs. In the same lesson, the teacher asked learners why plants are used for firewood as a starting point to explain how energy is stored and transferred from one form to another. T2 helped them understand how stored energy in plants can be used for firewood by using the burning of nuts as an example for clarity of reference to the respiration process. In LO16 the teacher defined a canal (for alimentary canal) using an example of canals found in the northern part of Namibia which most learners are familiar with. T4 also used an example of how meat is preserved at the farm as a way of explaining food additives and preservatives.

### **Teaching strategy 3: Asking questions and teacher presentation**

The strategy which was used most by all teachers was questioning. Questions were the main mode through which content was taught to the learners. Teacher presentation was also commonly used as every question posed was usually a result of teacher presentation or accompanied by teacher presentation. Here are few examples of how teachers used questions during the lessons:

### Example 1: LO1

Teacher: *What is the process called?*

Learner: *Osmosis*

Teacher: *How does the water move from the soil to the leaves?*

Learner: *Through the xylem.*

Teacher: *How does water go up against gravitational force?*

Learners challenged. Teacher explained transpiration pull and she immediately introduced transpiration by asking the following questions:

Teacher: *What is transpiration?*

Learner: *Transpiration is the process by which plant leaves lose water into the atmosphere.*

Teacher: *What will happen if plants lose too much water?*

Learner: *They will die.*

Teacher: *Why will they die?*

Learner 1: *They do not have water to carry out its 7 characteristics of life.*

Learner 2: *Will not photosynthesize.*

Teacher explained the wilting process and wrote factors affecting transpiration on the chalkboard.

Teacher: *Before I start explaining, tell me, what are the factors affecting transpiration?*

Learner 1: *Temperature*

Learner 2: *Sunlight.*

The teacher added wind speed, humidity and explained how the different factors affect transpiration. And then she said, "*But in the exam do not write sunlight but sunlight intensity otherwise you will not get a mark*". Short summaries given on the transparency, teacher said the learners should copy the diagram because it is not clear in the textbook.

Learners started copying the diagram; bell rang while they were not done.

Teacher: *Make sure you are done with the drawing before you go.*

Example 2: in LO13

T3 had just finished introducing the lesson with a short recap of what was done on conservation and its importance in the previous lesson. She then asked a few questions:

Teacher: *What is biodiversity?*

Learner: *Biodiversity means different species.*

Teacher: *Bio – means life/ living while diversity means – variety, therefore biodiversity is a number/range/variety of species in a habitat.*

Teacher: *Why do we need to maintain/conservate species?*

Learner: *To prevent extinction.*

Teacher: *What is wrong with species being extinct?*

Learner: *The tourism industry will suffer.*

Teacher: *What if there is no tourism? Why do we need to conserve species?*

Learner: *To maintain a balance in the ecosystem.*

(Teacher wants more reasons on why we need to conserve species)

Learner: *For human benefits such as wood, timber, for building, paper.*

Teacher added that species are also for conserving genes and for drugs (medicine).

Teacher: *How does tourism attract investors?*

Learner: Explains how tourism can increase business opportunities using a Namundjebo trading example (local business).

Learner: *Mrs. does attracting crime in tourism, include prostitution?*

Teacher: *Not really, (teacher partially explained).*

Learner1: *But teacher have you ever watched on TV, the way humans kill whales.*

Learner 2: *Also how people in Namibia have been having debates about taming cheetahs on TV.*

The teachers posed a lot of questions. The questions asked promoted one word answers or factual recall, for example in LO2 teacher asked “*What are sediments*”? In LO14, “*What is the name of the tissue that transports water in plants*”? In LO11 “*Which is the main source of energy*”? And “*What is the green pigment in plants called*”? In some cases teachers also probed further to promote critical thinking among learners, for example, in LO2 and LO14 learners were asked the

following questions, “*How does water move in the plant, why?*” “*Why do you apply pesticides in the phloem?*” “*Why are pesticides dangerous to plants? How do pesticides poison plants, “What do does the flower do with water?” Why do we need to conserve species (in LO13)?*”

#### **Teaching strategy 4: Using definitions**

All the teachers made use of this strategy, they often provided definitions to introduce and develop concepts in lessons. For example in LO11 on energy flow the key words such as producers, consumers, decomposers, carnivores and trophic levels were defined (see Table 4.7). P2 defined Genetically Modified Organisms (GMO’s), deforestation, water pollution, eutrophication, biodiversity, global warming, desertification and conservation in LO3 and LO4. T3 defined excretion, deamination and population. T4 defined words like egestion, food additives, digestion and ingestion (see Table 4.7). New words were defined to make sure learners understood them. In some lessons, learners were asked in the homework and class tasks given to find the meaning of unfamiliar words, for example, P2 asked learners to find out what is meant by ‘residues’ for homework.

#### **Teaching strategy 5: Project and investigations**

As indicated in Section 4.2.1, the syllabus has suggestions for investigation, for example for the topic of conservation taught in LO12 learners should be given an opportunity to discuss and propose different recycling projects in the community. If it is possible they should visit local recycling plants. Learners were asked to name local conservation projects in LO12 but did not have a chance to visit any recycling plants. For water pollution done in LO4, the syllabus suggests that, learners should carry out an investigation to compare oxygen demand in water from different sources, such as above and below a sewage outfall, using methylene blue as an indicator. It was not carried out in that lesson.

#### **Teaching strategy 6: Using demonstrations**

T3 used the demonstration strategy when she was explaining the human breathing system. She used a learner-made model of the respiratory system to demonstrate how the breathing system functions during inhaling and exhaling of air. P1 used her lipstick to demonstrate how substances move in the phloem of the plants. However P2, T1, T2, and T4 did not use this strategy or experiments for learners to observe, get results and finally draw their own conclusions.

### **Teaching strategy 7: Explaining and giving summaries**

In all lessons teachers explaining content was as common as the questioning strategy. Each lesson presented to the learners was fully explained. The explanations were sometimes supported with examples. However, conceptual understanding in learners emanating from these explanations was a matter of concern especially since their explanations were supported by examples drawn on the chalkboard and from the only reference they used for the subject. Learners were not shown practical examples. In most lessons, teachers wrote key words on the chalkboard or transparencies followed by explanations (see Appendix 8). It was, however, also observed that all teachers gave learners comprehensive and understandable summaries for almost every lesson taught (see Appendix 8), except in P1 lessons where she said she wanted the learners to do their own summaries as it helped them get more information than the syllabus required.

### **Teaching strategy 8: Assessment**

Various assessment methods were observed in some of the lessons. For example, homework was given in LO2, LO4, LO5, LO15, test dates announced in LO5, LO12, self-assessment in LO13 and project announced in LO11. It was also observed that teachers prefer assessing learners individually rather than as groups or in pairs. Teachers did give clear instructions for assessment, normally by writing on chalkboard, for example, in LO2 the teacher wrote on the chalkboard: *Homework. Module 1, page 218/219 activity 3, 4 and 5 and prepare for presentation on plants' adaptations.* And in LO4 "*Homework: page 278-280 of the new book, answer all the questions*". Even though there was assessment done in all the said lessons, no individual marking or monitoring of work or feedback was given in observed lessons. This made it difficult to analyse learners' work and progress in different lessons. Some questions given for assessment were more structured (see Appendix 6).

In some lessons the teachers' teaching strategies concentrated more on preparing learners for the examination. For example these were the statements made by teachers in the following lessons: In LO13, "*It is important to know the advantages and disadvantages of tourism, they normally ask for 2-5 marks on importance of tourism or advantages and disadvantages of tourism ...*"

In LO14, “Be able to give and explain the advantages and disadvantages of pesticides, it can go for an exam question of 20 marks for higher level” and “... use scientific terms when explaining your work, the exam marks are allocated for terminology, especially for higher level paper 2, section B”.

In LO2, “Look at activity 4, for higher level the question will be, explain movement of water from the roots to the air/leave, give a detailed explanation and diagram, and for ordinary level your type of question will be similar to the one in activity 4”.

This strategy was more evident in LO12 where the teacher said the following during her presentation:

*For the exams, be able to define conservation and name the importance of conservation. For principles of recycling of materials, we spoke about sewage treatment; sometimes they ask you to label the sewage system. You should also be able to discuss one local conservation project, its importance and discuss problems of implementing such projects. Also important is an S-curve graph that you should be able to label and to explain what happens at all stages/phases. Be able to explain factors that influence the rate of population growth. You might even be given a plant or flower to name these factors ... not predators but water, food, pesticides, nutrients etc. Definition of population is also important to know.*

#### **4.4.3 Other enabling and constraining factors influencing EL as observed**

##### **4.4.3.1 Learner participation and motivation**

According to my observations, there was minimal learners’ engagement in most lessons. Teachers talked most of the time, they initiated all content and activities, learners experience and knowledge were not explicitly used in instruction. Learners mostly sat listening to the teacher presenting the lesson, few took notes. This was evident in LO2, LO8, LO12 and LO15. In some lessons presented, learners were engaged in personal conversations, this was evident in LO6, LO9 and LO17. In cases where the teacher posed questions, it was mostly the same few learners who answered and they were also the few who sometimes asked the teacher questions when they did not understand. P2 kept saying “... it is the same group of people answering all the time, what is happening to the rest...”. In LO4 learners were involved in a discussion, while in LO14 some were reading out their answers and making corrections to the self assessment activity.

There was hardly any learner to learner interaction observed in the lessons, most interaction happened between teacher and learner, except for a few cases in P2's lessons, but he, however, discourages debates.

It was observed that, despite the teachers' efforts, discipline and control was poor in some lessons, for example, in LO8 and LO16. In LO11 when the teacher announced that they would do a project on food chains and food webs most of the learners were negative about it, they complained that there was no more time for projects, as it was almost time to prepare for exams (but it was still a month before exams commenced).

#### **4.4.3.2 Teaching aids and textbooks**

In my observation, the chalkboard or/and overhead projector were the main teaching aids used (see Appendix 7). The lesson objectives, new words, short summaries, drawings, instructions were all written on the chalkboard or transparencies. For example in LO10 the teacher wrote the lesson objectives and key concepts that learners needed to understand during the lesson such as food chains, food webs, producers, consumers and decomposers on the chalkboard. However, even though the chalkboard and transparencies were the main teaching aids used, they did not really engage learners except to copy the notes, diagrams and instructions for homework. In LO1 and LO2 learners were not even allowed to copy the notes, and in other lessons, learners were not able to finish copying summaries.

It was observed that in most lessons learners had textbooks. The textbooks were used either to teach learners in the classroom or for learners to complete the tasks. In some lessons, the teacher referred the learners to the textbooks to find the solutions to the problems, for clarity of content being taught or for homework. For example in LO7, "*for explanation on the importance of desert animals having a long loop of Henle go to page 342 of your textbook*" and in LO2 "*for homework, go to page 218/219, Activity 3, 4 and 5*". I observed that P1, P2 and T1's classes had no displays on the walls. In T2's class there were only two posters on the wall made by learners. T3's class had posters on different ecosystems. T4 had a mixture of wall displays.

#### **4.4.3.3 Time and time management**

All lessons observed were on a 7 day cycle, 40 minutes each and there are no double periods (see Appendix 11).

#### **4.4.3.4 Classroom conditions**

Some classes are 'full', T2 does not have enough chairs and desks, some learners remain standing the whole lesson. All classes have a random arrangement.

#### **4.4.3.5 Integration**

In some lessons, the teachers encouraged learners to use knowledge from other subjects to answer questions. For example in LO2 the teacher told the learners to use their Mathematics knowledge to calculate time taken for water to move in the xylem. In LO3, LO4, LO15 teachers asked learners to use their Geography knowledge to define deforestation, desertification and water pollution, and Chemistry knowledge to describe the composition of gases in the air. While in LO11, the teacher wanted learners to use their Agriculture knowledge to answer the questions.

#### **4.4.3.6 Teachers' knowledge**

It was evident from my observation that teachers were confident when teaching EL especially the way they introduced and used new concepts, this was observed in terms of body gestures and language (used a lot of scientific and EL terminologies with ease, example deforestation, eutrophication, global warming, translocation) and the way teachers spoke with confidence. Teachers did have knowledge on the learning objectives presented and had, in most cases, addressed the assessment objective verbs (see Section 4.2.1.2). In most lessons there were no detailed explanations (differentiation) that went beyond the syllabus objectives.

#### **4.4.3.7 Teachers' pedagogical style**

Teachers' pedagogical styles only seem to prepare learners for exams not everyday life. Teachers used almost similar pedagogical methods to present the content.

#### **4.4.4 The learners' work/handouts and responses**

Learners were given handouts in some lessons. In LO1-LO7, they were given handouts for the summary on excretion and excretory products, in LO12-LO14; they were given handouts on human impacts on the ecosystem and conservation. LO14 was a question and answer lesson, thus the questions on the handout were on the questions done in class (see Appendix 12). The work on the handouts was related to the lesson objectives. The handout on ecosystems and

conservation showed that teachers asked recall and more of one word answer questions and few questions that promoted critical thinking (see Appendix 6).

The orientation in the question papers was similar to most of the questions in the activities given by the teacher during the lessons for assessment.

#### **4.5 Conclusion**

In this chapter I have presented findings from interviews, lesson observations and document analysis. I shared information on how EL is taught in Namibia, in the Biology curriculum. It provided a profile of all the participants in the process, and a detailed description of the study is provided through 'thick description'. There were a few mismatches between curriculum expectations, what the teachers *said* and what they *did* in their actual practices. A number of enabling and constraining factors were identified through the analysis. The next chapter reviews the findings as presented in this chapter in more depth, and provides a critical discussion of these, drawing on insights into curriculum implementation and the Namibian education system as outlined in Chapter 2.

## CHAPTER 5

### ENVIRONMENTAL LEARNING IMPLEMENTATION IN BIOLOGY CURRICULUM: ENABLING AND CONSTRAINING FACTORS

#### 5.1 INTRODUCTION

In this chapter I discuss insights on EL implementation in the Biology curriculum. The discussion is substantiated by pointing to evidence as presented in Chapter 4 and making reference to the key ideas and concepts highlighted in the literature review. In discussing the findings I developed analytical statements that directly relate to the key research questions informing this study as described in Chapter 3. In line with the main goals and objectives of the study, five analytical statements are discussed, out of which I will make my concluding remarks regarding EL in the context of Namibia's Biology curriculum practice.

- Analytical statement 1: Teachers' knowledge and interest in environmental education influence how teachers facilitate EL.
- Analytical statement 2: There is a mismatch between EL theories and practice.
- Analytical statement 3: Teaching of EL is mainly informed by the syllabus and not other curriculum documents.
- Analytical statement 4: Current assessment policy and practice impact on EL.
- Analytical statement 5: Various enabling and constraining factors influence EL both present possibilities exist for improving EL in Namibia's Biology curriculum.

The analytical statements will then be discussed in detail. The analytic statements will be used to make key recommendations in Chapter 6.

## **5.2 Analytical Statement 1: Teachers' knowledge and interest in environmental education influence and how teachers facilitate EL**

- EL has been integrated in the Biology curriculum policy documents that guide teaching with the intention to benefit learners and society (D1-D4, P2, T3, and T4). The views expressed by the teachers about the infusion of environmental learning coincide with those of Enviroteach (1995); Gough (1997); Lotz-Sisitka (2002) and SEEN (2005) that EL is integrated in many policy documents and across the curriculum. Environmental topics are across the curriculum, but the infusion of environmental topics in the Biology curriculum is inadequate, thus more EL should be added to the Biology syllabus (P2, T3 and T4). In regard to this, Stevenson (1997) and Peden (2008) argue that there is no need to add new facts or themes in education but to rather renew educational concepts and approaches by strengthening the meaning and substance of EL content. Teachers involved in this study expressed positive views about the importance of EL (see Section 4.3.2). This concurred with Stewart (2001); UNESCO (2008) and Lundholm and Plummer (2010) who emphasized the importance of environmental learning as a vital component to solve environmental problems. However, as the results show, these positive views do not appear to be translated into practice given the type and number of the facilities available at schools.

The study showed that more successful teachers in implementing environmental topics are those who were more interested in the environment, and those who had more students who showed interest in the environment (P2, T1 and T3). This is supported by Shuman and Ham (1997) who noted that despite the barriers to teaching EL, some teachers pull through towards teaching EL because of their positive attitudes toward environmental education and their feeling of responsibility *for* the environment (see Section 2.6). It is evident that the teachers who are interested in and have a positive attitude towards the environment do more to teach environmental topics despite some of the constraining factors to teaching EL (see Section 4.3.4.7). Rosenberg (2008) also supports this by emphasising the significance of teachers' motivation in EL.

Teacher training programmes have limited access to environmental education content and methods (T3). EL development projects reported that developing an environmental education

perspective has posed pedagogical challenges for Biology teacher educators. However, Biology teachers are fairly knowledgeable about EL and have no doubts when teaching environmental topics. The teachers gained their EL knowledge through experience and/or exposure and through studies which indicate that the Basic Education Teachers Diploma EL initiatives (Life Science, Enviroteach, SEEN projects) may have had some influence. Teachers demonstrated knowledge on the learning objectives presented even though in most lessons there were no detailed explanations (differentiation) that go beyond the syllabus objectives. In this regard Peden (2008) and Uugwanga (1998) commented that teachers are not well prepared to integrate EL in their classrooms. The table below shows evidence of teachers' knowledge in lessons observed in relation to the curriculum expectations.

**Table 5.1 Teachers knowledge and curriculum expectations**

<b>Teacher</b>	<b>Curriculum/syllabus knowledge expectations</b>	<b>Teachers knowledge: Evidence in lessons</b>
<b>P1</b>	Know water uptake, transpiration and translocation in plants and understand the importance of these processes for plants	<ul style="list-style-type: none"> <li>•Use of lipstick to demonstrate movement of substances in the plant, using scientific/EL concepts to explain the work</li> <li>•Linking the lesson objectives to learners' experience</li> <li>•Use local examples to explain terminologies for example translocation</li> </ul>
<b>P2, T3</b>	Consider the need for conservation of species, their habitats and natural resources	•Using local examples to teach conservation and learners knowledge to help them understand the importance of conservation of species and habitats
<b>T1</b>	Acknowledge the necessity to remove toxic waste products of metabolisms	•Uses a lot of diagrams to explain the lesson objectives and uses scientific concepts
<b>T2</b>	Understand flow of energy through the ecosystem	<ul style="list-style-type: none"> <li>•Use local examples of animals and plants to explain the food webs and food chains</li> <li>•Able to use a lot of diagrams on chalkboard to explain the food chains and food webs (energy flow)</li> </ul>
<b>T4</b>	Know the structures and functions of the human alimentary canal	•Drew on learners' prior knowledge to explain the work, used known examples to define terminologies example alimentary canal

What the teachers teach is considerably influenced by what they know and feel, this is evident in P2's case who indicated that "*apart from the syllabus, I am guided by my instincts thinking this is right and this is wrong*". Untrained teachers cannot produce environmentally literate learners. Hence, the teachers are the key determinants in EL implementation in class and their concerns

and attitudes are in turn an influential factor (Fien, 1993; Cotton, 2006). The data showed that all teachers were appropriately qualified to teach Biology (see Section 4.3.1).

The teachers' knowledge influences their pedagogical content knowledge, which is discussed next.

### **5.3 Analytical statement 2: There is a mismatch between EL theories and practice.**

The key elements of EL identified in this study are theory and practice, fieldwork, learner-centred methods, learner participation, learners' prior knowledge and project work and education *for* the environment. These key elements are discussed to show the mismatch between EL theories and practice.

- **Theory and Practice**

Data in Chapter 4 revealed that, the Biology curriculum EL orientation is too theoretical (see Section 4.2.4). In Chapter 2 it was argued that EL is best taught and learnt when theory and practice are combined together (Chi-chung Ko & Chi-kin Lee, 2003; Ketlhoilwe, 2003). In order for EL to be successful it should be facilitated both inside and outside the classroom situation. The Biology curriculum aims at developing skills among learners (see Section 4.2.1.1). The learning process is amplified by linking science and real life situations in the environment (D2, D3 and P1-T4). As reported in Chapter 4, teachers used local and familiar examples where possible to explain and clarify things to the learners. However, these examples did not really spark off discussions during the lessons (see Section 4.4.2). Usage of local examples and context is said to enhance meaningful learning as argued by Monroe and Kaplan (1988); UNEP (2006) and Hogan (2008) who highlight the importance of using everyday contexts and experience in EL.

- **Fieldwork**

The study found that fieldwork is seldom conducted due to transport, cost and time constraints (P1-T4) even though teachers were conscious of the value and need for it. All teachers' teaching methods confined them to the classroom, no outdoor lesson was observed (see Section 4.4.2).

The school environment is seen not to be conducive for implementing EL and the existing curriculum is too theoretical and not suitable for the infusion of EL. It was evident from the study that teachers involved in the study are well aware that EL is practical based and cannot be taught without being outdoors (T2 and P2). They would like to take learners out into the field and expose them to real environmental issues as described in Section 4.3.4.3 but there are constraints. This resonates with Stimpson (1997); Chi-chung Ko and Chi-kin Lee (2003) and Kettlehoilwe (2003) who emphasized that the theoretical nature of subjects and other factors constrain fieldwork and outdoor learning.

- **Learner-centred methods**

Biology teachers use a variety of teaching methods to teach environmental topics and among them are learner-centred strategies (see Section 4.3.3). The use of teaching strategies in the classroom is determined by the type of resources available (P1, T4). Common teaching methods used are questions and explanations. Teacher-centred methods seem to be more valued (see Section 4.4.2). Some teachers occasionally use other methods such as informal discussions and telling learners to find information prior to the lessons. Most teaching strategies were often used in a technical rather than reflective or problem oriented manner. Showing video clips and taking learners out on field trips or outdoor activities were teaching methods that teachers have not used but would like to use. Stimpson (1997) argued that on average teachers' teaching styles were more teacher-centred and lectures were the most popular teaching methods. Stimpson found that experiments were also a popular teaching method for environmental topics but in this study no experiments were carried out to facilitate EL.

- **Learner participation**

Despite the policy focus on learner-centred strategies reflected in the document analysis in Section 4.2.2, participation of learners is not valued in EL lessons. Teachers in this study pointed out that they engage learners in EL lessons (see Section 4.3.3.), but it was observed that learners' engagement and participation was minimal except for copying summaries and answering the teachers' questions and in a few cases asking questions (see Section 4.4.3.1). Learner to learner interaction is not valued in the lessons. This does not fully support D2, Lee (1997); Mubita (1998); Kettlehoilwe (2003); Lotz-Sisitka et al. (2006); Kostova and Atasoy (2008) and Silo

(2009) who all emphasise the importance of learner-centred approaches actively involving learners in the learning process. Learners should be involved as partners in, rather than receivers of education (Namibia. MoE, 2009). Dahlstrom (1995); Mubita (1998); Hogan (2008), however, also note that learner-centred approaches involve community members in formal education, hence EL; this would help bridge the gap between schools and communities.

- **Prior knowledge**

Evidence in D2 shows that utilization of learners' prior knowledge in teaching and learning is important for EL (see Section 4.2.2). There is a diversity of learners in the classes; these learners give examples related to their own experiences and opinions based on what they do in their different communities and cultures (T1, T2, T3 and T4). Even though teachers use learners' experience and knowledge, it was not very explicit in the lesson instructions. The lessons did not really demonstrate how teachers used learners' prior knowledge; although there were some instances where the teachers drew on learners' knowledge (see Section 4.4.2). However, T2 does not completely agree with the views on learners being able to use their prior knowledge, his opinion is similar to Kasanda et al. (2005) who state that learners cannot relate their daily experiences, they do not see themselves as being involved in teaching and learning. As a result there is a mismatch between learners' everyday worlds and school worlds.

- **Project work and education *for* the environment**

Extramural activities or projects provide knowledge, skills and awareness and action to learners and communities (Monroe & Kaplan, 1988; Lee, 1997; Cotton, 2006; Rosenberg, 2008). Thus schools should have environmental projects or clubs and promote project work in lessons for learners to practice their knowledge and skills (D2, D3). But evidence from this study shows that there are no projects at the schools involved in the study for learners to practice their knowledge and skills. Only cleaning campaigns are sometimes done at schools, and this can help learners to understand why it is important to keep their areas clean (see Section 4.3.4.8), but this is also a very limited experience if it is the only one. Similar to Ketlhoilwe (2007) who notes that teachers tend to emphasise school ground cleaning as a main environmental education activity. Involving learners in action projects can empower them in a sense and develop action taking skills, thus

help learners become environmental problem solvers as argued by Jensen and Schnack (2006) that using action oriented approaches are important in the field of environmental education to create awareness and foster environmental knowledge. Study data also shows that action projects are not carried out in Biology lessons because of constraints including short class periods, inability to leave the school, and lack of materials to guide the process (see Section 4.3.4.3 and 4.3.4.5). These findings are, however, similar to those of Monroe and Kaplan, 1988; Ketlhoilwe, 2003; Kasanda et al., 2005. Despite Fien (1993) and Lee (1997) who argue that a range of teaching approaches and strategies should be used to provide opportunities for learning *about*, *in/through* and *for* the environment. Data in this study shows that similar to Fien's (1993) observation that teachers put more emphasis on the approaches of education *about* and *through* the environment, abandoning education *for* the environment.

This is despite the fact that the Namibian curriculum documents note that education *for* the environment encourages critical thinking and promotes environmental consciousness (Namibia. MoE, 2009) and despite the SEEN and Enviroteach projects emphasis on the importance of environmental education. Thus, it would seem that the way teachers interpret curriculum documents has an influence on their teaching practices regarding education *for* the environment. The following analytical statement discusses how the curriculum documents inform teaching of environmental topics.

#### **5.4 Analytical statement 3: Teaching of EL is mainly informed by the syllabus and not other curriculum documents**

Curriculum documents are intentionally designed to promote teachers' learning about content and pedagogy (D2) (see Section 4.2.2). These documents can be adapted to suit certain topics and contexts. Teachers can thus situate the curriculum materials to their own situation. Despite there being a range of curriculum documents the primary source of information of teachers in this study, was the textbook (see Section 4.4.3.2). Teaching and learning was primarily determined by what is in the textbook. Little attempt was made to adapt the textbook knowledge to learners' own situations. Other curriculum documents were not often used by teachers in this study to inform teaching and learning, and it was found that teachers either do not have them or

they do not find them effective for environmental learning implementation. This finding is in contrast to Beyer et al. (2009) who place emphasis on the importance of curriculum documents in teaching.

D2 emphasised that teachers should meet the requirements of the syllabus. All teachers' involved in this study, prioritised covering the Biology syllabus. Teachers prefer to use the Biology textbooks to help them achieve the syllabus objectives. They found textbooks to be consistent with the syllabus learning objectives; especially the NAMCOL ones (see Section 4.3.4.2). Most learners observed in this study have textbooks. The textbooks are mainly used either to teach learners in the classroom or for learners to complete the tasks on their own or for homework. In some lessons, the teachers' referred the learners to the textbooks to find the solutions to the problems, for clarity of content being taught, or for homework. For examples of those practices (see Section 4.4.3.2). Thus, similar to Chi-chung Ko and Chi-kin Lee's (2003) findings, the study showed that many teachers relied on textbooks when teaching environmental topics and that teachers main concern was fear of "not covering the syllabus" (p.200).

Despite the effectiveness of the textbooks and syllabus as pointed out by teachers, both the textbooks and syllabus have suggestions for practical work or demonstrations, but not to a large extent. The textbooks are more theoretical and focus more on the subject content rather than skills development as reported in Section 4.2.4. This might be a contributing factor to the earlier insight that teachers tend to put more emphasis on teaching knowledge, rather than attitudes and skills in their teaching of environmental education. Nonetheless, they aim to focus more on attitudes. This was to some extent congruent with the observations and findings of Chi-chung Ko and Chi-kin Lee (2003), that while teachers believed that the cultivation of environmental attitudes was important in environmental education, they tend to use textbooks which facilitate the transmission of knowledge and the coverage of the syllabus. This raises questions for the future development of environmental education within the Science curriculum: What environmental values and attitudes should be promoted in the Science curriculum and teaching, and how could or should these be presented in the syllabus and the textbooks?

The study also shows that the Biology textbook does not fully promote the goals of "key transferable skills" (Kadhila, 2008). These include critical thinking, analytical skills, problem solving, communication skills, numeracy skills, information skills, study skills and creative skills

among others. And despite the key emphasis on learner-centred approaches, the textbook does not promote participation, cooperative learning or action taking (see Section 4.2.4). As indicated in Chapter 2 (see Section 2.4.2) the SEEN and Enviroteach projects have helped with materials development for EL but these might not be available to the teachers in this study as they did not mention them.

The mismatch between teachers' practice and expectations of the curriculum may be because teachers involved in this study do not have the curriculum documents or they do not make use of the documents. The next analytical statement discusses how assessment is integrated in teachers' lessons and its impact on EL.

#### **5.5 Analytical statement 4: Current assessment policy and practice have an impact on EL**

As reported in Section 4.2.1.2, Grade 11 and 12 Biology learners write three compulsory exam papers at all levels (D1). The Biology teachers involved in this study recognized assessment as important for testing learners' understanding of environmental topics (see Section 4.2.1.2). As reported in Section 4.3.3 and Table 4.3, different types of methods are used to assess learners' performance on environmental topics. Some questions given for assessment were more structured to test how learners operate at and beyond comprehension level.

In the lessons observed in this study, questions were the main mode through which environmental topic content was delivered to the learners (see Section 4.4.2). But the types of questions asked did not promote critical thinking and problem solving. There was, however, an observable link between the textbook activities; informal questions asked in class; and examination questions. Most of the questions asked by the teachers in this study seemed to promote factual recall and not learners' practical skills (see Section 4.4.2). This contrasts with the aims of the syllabus and EL objectives of promoting critical thinking and problem-solving skills. This appears to be a wider issue, however, Malcolm (undated: 20) argues that "environmental education development and implementation is seriously hindered by an emphasis on traditional assessment methods". Kostova and Atasoy (2008) note that for successful EL, teachers should be able to facilitate EL by stimulating learners to ask questions, reacting to their answers, helping them accept challenges and disagreements, discuss contradictions, think critically and offer creative solutions.

Data in the study shows that assessment of environmental topics can help teachers to undertake critical reflections on the lessons (D1, P1-T4); this is, however, not always practical in some teachers' cases because of the workload (T3). In this regard, Shulman (2004) states that teachers' lesson plans ought to show assessment approaches to be used. This helps teachers to review their lessons afterwards, which then constitutes reflection.

The study also found, at least amongst those involved in the study, that teachers do not give much attention to environmental topics because they are not examined much (see Section 4.3.3). They spent most of their time on examination related activities, which may explain why they lack the time to teach environmental education. Environmental topics that are examined influence the implementation of environmental topics (T2), a point which is also made by Chichung Ko and Chi-kin Lee (2003) and Ketlhoilwe (2003). They state that EL is hardly examined and teachers pay most attention to examined work during their implementation of environmental education.

There are also, however, other constraints that make it difficult for teachers to meet the EL aims discussed in the analytical statement which also deals with how constraints can potentially be translated into enablers for successful EL.

## **5.6 Analytical statement 5: Possibilities exist for improving EL in Namibia's Biology curriculum.**

- **Integration**

The study found that, there are fewer environmental topics in the syllabus which also influence their implementation. T2, T4, and P1 pointed out that more topics should be added for EL to make a positive impact in their implementation as well as for learners to start showing interest. There are a lot more personal and logistic barriers that hinder the successful implementation of environmental topics such as class sizes, learners' discipline and knowledge, lack of lesson preparation and the vastness of environmental issues at schools (see more in Table 4.5). All these constraints are similar to those of Loubser (1997); Uugwanga (1998); Ketlhoilwe (2003); Hoabes

(2004) among others in Chapter 2. These constraints are discussed below, and all these constraints have a potential to be translated into enablers for successful implementation of EL. These can be achieved through interventions from different stakeholders in education and organizations, for example through providing knowledge-rich resources for EL as suggested by Rosenberg (2008).

- **Resources**

A variety of materials are used to enrich and assist in achieving lesson objectives (D2). Teachers improvise teaching and learning by using easily available objects in the immediate environment (P1, D2). The resources at schools are inadequate to facilitate EL. This aspect is highlighted by teachers in the interviews. Teachers said they do not have most of the teaching and learning resources such as textbooks and laboratories. This means facilitation of EL in Biology is compromised. This is supported by Uugwanga (1998); Hoabes (2004), Hogan (2008) and Rosenberg (2008) who reported on resources as barriers to EL.

- **Lack of support from different stakeholders**

Success in EL implementation depends on a good communication network between teachers, management, community or parents and advisory teachers (D2). The advisory teacher has extensive knowledge of the relevant subject area, in this case EL within Biology (D2, T3). Emerging from the study it was found that most teachers involved in the study felt the necessity of EL, but little EL is taking place in their Biology EL lessons because of lack of commitment and support from some parents and community members, advisory teachers, colleagues and some school management in the implementing of environmental topics (see Section 4.3.4.1 and Table 4.4). This is supported by Ketlhoilwe (2003) and also resonates with, Fien (1993) who revealed that development of critical thinking and problem solving among learners has failed because of lack of support from education authorities. Uugwanga (1998); Hoabes (2004); Cotton (2006); Hogan (2008); Rosenberg (2008) also note that lack of inadequate support from school management, the Education Department and some community members is a constraint to effective EL implementation.

- **Inadequate in-service training**

Evident from D2 is the emphasis on professional development of teachers through pre-service and in-service training. There should be workshops and in-service training of teachers where teachers share information, materials, experiences and new strategies. But despite that, the teachers' workshops and in-service training are inadequate in Biology, specifically regarding environmental learning (P1-T4) (see Table 4.3). This will call for more teachers training. This is supported by Ketlhoilwe (2003); Hoabes (2004) and Peden (2008) who indicate that there is a need for teachers' in-service and pre-service training.

- **Lack of time**

Lack of time allocated for Biology as a subject is one of the main constraints to effective implementation of EL. The time allocated for environmental topics is inadequate to combine theory and practice in teaching environmental topics. The period allocated for Biology on the timetable of these schools was a matter of concern (P1-T4). Instead of allocating double periods as indicted in D2 to provide enough time for discussions, practical work or experiments, single periods were allocated throughout the timetable. It is unlikely that a single period of a maximum of 40 minutes will accommodate both theory and practice. Double periods would have been more appropriate to assist in allowing time for both practice and theory to help learners make a connection. There are, however, also a lot of school activities that compromise the teaching time (P2, T2). Teachers do sometimes arrange afternoon sessions to complete the tasks, but that is a serious concern as learners do not turn up in numbers in the afternoons (P2, T1 and T4). This is in line with Ham and Sewing (1988) who note that, lack of class time and preparation time were perceived as the greatest barriers for implementation of EL.

- **Class size**

Data from the study indicates that class sizes constrain effective implementation of EL (P1, P2 and T4). The large class groups make it impossible for group work and other learner-centred activities. In this regard Uugwanga (1998) and Ketlhoilwe (2003) note that large class sizes constrain EL implementation.

- **Lack of learners' discipline**

Despite the clear focus by D2 in Section 4.2.2.6, that teachers should establish a disciplined teaching and learning environment, it was observed that in some classes learners were not disciplined. This, however, was also indicated by the teachers in this study (P1, P2). A point which was also made by Rosenberg (2008) that some schools are characterised by a lack of discipline which contributes to ineffective EL.

- **Lack of fieldtrips**

As discussed in Analytic Statement 2, the study found that teachers involved in the study do not take learners out for fieldwork because of transport and cost implications (P2, T2). This resonates with Chi-chung Ko and Chi-kin Lee (2003) and Ketlhoilwe (2003) who note that school environments are not conducive for outdoor activities, thus suggesting that conducive learning environments should be created at schools to supplement theoretical classroom activities.

- **Lack of knowledge and exposure**

D2 indicates that teachers should be qualified to teach the subjects and should have the subject matter (see Section 4.2.2.5). Teachers involved in the study pointed out that they are fairly exposed and knowledgeable when it comes to EL and they are all qualified to teach Biology (see Table 4.2). This is supported by Hoabes (2004) who notes that teachers are qualified to teach the subject they teach. But like Uugwanga (1998); Ketlhoilwe (2003); Nelson Mandela Foundation (2005); Rosenberg (2008) and Peden (2008), T3 indicated that teachers are not well prepared to implement EL. T2 and T4, however, indicate that there is lack of EL knowledge among learners (see Section 4.3.3) whereas T3 indicated that there is lack of exposure to EL among learners. A point made by Ketlhoilwe (2003) that there is lack of EL knowledge in schools.

## **5.6 Conclusion**

This chapter has provided an interpretation and discussion of the data as presented in Chapter 4 using some of the literature reviewed in Chapter 2. Insights were captured and reported

according to a set of analytical statements, and each was discussed in some detail, the analytical statements in this chapter will be used to make key recommendations in Chapter 6.

## CHAPTER 6

### CONCLUSIONS AND RECOMMENDATIONS

#### 6.1 Introduction

This chapter presents a summary of the study and its main findings. It then suggests some recommendations within the case of environmental topics implementation in the Biology curriculum but which may be applied in other contexts of environmental education practice, in particular in schools. Finally, the chapter makes recommendations for further research.

#### 6.2 Summary of the study

The study reported how the selected Biology teachers in the Namibian context implement EL. The experience and passion I have in the field led me to researching how the Biology teachers implement EL. The result of the investigation helped me reflect on my own teaching and has contributed to a broader understanding on how to facilitate EL and improve my effectiveness as a Biology teacher. The results of the investigation also contributed to a broader understanding and to the existing knowledge of EL in the Biology curriculum.

This study was constituted as a case study of two schools in Windhoek, in the Khomas region. The study focused on Grade 11 and 12 Biology teachers. The study investigated the implementation of EL in the Biology curriculum, and the constraints and enabling factors influencing the implementation. The study employed qualitative methods, specifically semi-structured interviews, classroom observations and document analysis in its investigation of EL implementation. Purposive sampling was done and piloting of interview and observation schedules was used to refine the schedules. Ethical issues were taken into consideration throughout the study. Due to financial, time and geographic constraints the study was only carried out in two schools, but despite these limitations, the study provided an initial understanding of Biology teachers' ways of implementing EL in the Namibian schools involved in the study and some implications for curriculum and teachers' development for EL in the future became evident. The findings from the study will not be used to generalize how Namibia Biology teachers implement EL in Grade 11 and 12.

The study found that, Biology teachers involved in the study do implement EL but not to a large extent. The teachers used various teaching strategies to teach environmental topics but the common teaching methods were the teacher-centred strategies. The study found that Biology teachers involved in the study had fair knowledge and experience of EL and their attitudes and interest towards EL influenced the way they facilitated EL in their classrooms.

The study further found that there is a mismatch between EL theories and practice because of constraints of effective EL implementation. Evidence from the study is also that, teaching of environmental topics in the Biology curriculum is mainly informed by the syllabus, and the current assessment policy and practice have an impact on EL. The study also found that there are a number of constraints and enablers that influence EL implementation, amongst them are inadequate resources, lack of support for teachers from different stakeholders, lack of interest and discipline among some learners, no fieldwork carried out because of cost and transport implications, inadequate time allocated for EL and lack of in-service training for teachers involved in the study on EL. The study concludes that EL implementation can be improved in the Biology classrooms involved in the study by translating the constraints into enablers and the enablers can be maximised.

### **6.3 Recommendations**

Some of the pertinent recommendations associated with the findings of this study include the following:

#### **1: Strengthen the subject content and interest of teachers**

The study found that teachers involved in the study do not have enough knowledge of EL. Lack of in-service and pre-service training is the main contributing factor to teachers' lack of knowledge. Most of the Biology teachers involved in the study did not receive much environmental education when they were students and student-teachers. The study thus recommends more comprehensive environmental education in-service and pre-service programmes for Biology teachers involved in the study on EL. Teachers involved in this study need to be trained to be equipped with deep knowledge that will enable them to address

environmental issues adequately. As reported by Peden (2008) that deep knowledge is a prerequisite for critical thinking. Without an understanding of the science of key environmental issues responses will remain superficial and inappropriate. Substantial environmental education should be provided for pre-service teachers. If more teachers understand the need and approaches related to education *for* the environment, promotion of environmental education among teachers will be far easier. Teacher training is also necessary because environmental knowledge informs the pedagogy of teachers. If teachers themselves do not receive enough environmental education, how can they be expected to teach actively *for* the environment? Therefore, attention should also be paid to teacher education for environmental education. More projects similar to SEEN and Enviroteach projects can be established to promote environmental education for educators or current SEEN projects can be expanded to reach more Biology teachers. The study also recommends the promoting of EL interest among teachers for better EL implementation. This can be done through meetings at school both at regional and cluster level.

## **2: There should be a match between EL theories and practice.**

Teachers involved in this study depended more on some type of teaching methods especially questions and explaining of subject content in the class. The study found that most teachers involved in the study use teacher-centred methods as a way of transmission of knowledge. The study thus recommends that teachers should move away from teacher-centred approaches to learner-centred approaches such as group work, experiential learning and debates. The Biology teachers involved in the study should find flexible and open-ended ways to present environmental concepts that will allow learners to draw their own conclusions about important environmental and societal issues. Regarding teaching methods, the study also recommends that a conducive school and community learning environment should be created for more opportunities for fieldwork and projects to supplement more theoretical classroom activities. As suggested by Ketlhoilwe (2010) on EL epistemological and pedagogies practices, there is also a need to interrogate the possible epistemological and pedagogical practices in the Biology curriculum to find new ways of implementing environmental topics to enrich learners, expand their agency, and enhance reflexivity and responsiveness to risks. This can be done through a participatory mode by stakeholders from various formal and informal education sectors.

### **3: Reorientation of curriculum documents and other learning support materials used for environmental learning**

The study found that, teachers involved in the study highly depend on the syllabus and textbook for teaching environmental topics. The study recommends that all necessary curriculum documents should be revised accordingly and be made available at schools. Materials that will encourage EL links to learner's everyday lives contain opportunities for fostering discussion around values, beliefs and encourage linking of theory and practice that promote learners participation and decision making. Therefore the study recommends that the Biology textbooks should include more local example and practicals. The study also found that the Biology textbooks are more theoretical and focus more on the subject content rather than on skills development. More practical scenarios from the local sources should thus be added to the Biology textbook. The textbooks should allow participation and give learners opportunities to be actively involved in solving environmental problems. The Biology textbooks should also include more group work tasks that will encourage cooperative learning.

### **4: Change in assessment approaches**

The study found that environmental topics are not examined, this negatively affects the teachers' implementation of these topics. Thus the study recommends that more environmental topics should be examined both at internal and external examination level. In terms of assessment, it is necessary for teachers to assess learners as part of their pedagogy. In regard to this, the study recommends that, more activities and questions asked should mobilise learners' prior knowledge, promote critical thinking and reasoning and engage learners in problem solving. Learners are supposed to become problem solvers, if they do not get the necessary skills and knowledge they will not be competent for that.

### **5: Constraints of EL should be translated into enablers**

The study found that in this case concerned inadequate resources, no field trips and lack visualization (video clips) are the main constraints. The study thus recommends provision of

teaching materials such as video clips for teaching. Making available field trip resources such as guided environmental tours, preferably related to EL would be beneficial to the promotion of education *in* the environment. Environmental education resources could also be produced by nongovernmental organizations and teacher education institutions as have been done by DRFN on Enviroteach projects and Polytechnic of Namibia with the SEEN project. The resources may be designed to support action taking, and to present learners with opportunities to take local actions. Learners could investigate potential action projects that would enable them to make a difference in improving their environments.

Regarding other constraints, the study further recommends that,

- Teachers involved in the study receive support from other teachers, school management, the Education Ministry, community members and cluster schools. Support rendering is essential for higher level of change.
- Regarding time allocation for EL, the study recommends double periods in Biology to provide enough time for practicals and outdoor learning.
- Biology teachers involved in the study should be empowered to realize their vision of acting as agents for social change and working for the betterment of the environment, these teachers should have an opportunity to communicate environmental values and perspectives and act upon curriculum decisions related to EL rather than just relying on textbooks.
- Motivate Biology teachers involved in the study and learners on the importance of and their role in EL.

To develop EL in the Biology curriculum, the constraints to teaching environmental topics should be reduced and enablers should be maximised.

#### **6.4 RECOMMENDATIONS FOR FURTHER RESEARCH**

- Further studies should be conducted on EL pedagogies, conceptions of environmental issues and attitudes towards the environment amongst Biology teachers, learners, head teachers and education officers.
- Further research could be done on the same topic, but including more stakeholders such as learners, school management, parents/community members and advisory services.

- How can teachers be helped to shift away from a teacher-centred approach to a student-centred approach to environmental education that emphasizes the cultivation of students' positive attitudes toward the environment? Education *for* the environment?

## **6.5 CONCLUSION**

This final chapter of the study has made recommendations related to the case and recommendation for further research. In a concluding chapter it is worth noting that, the study has researched how the Biology educators in a specific context facilitate environmental learning for learners to acquire relevant knowledge, awareness, values and skills. An analysis of teachers responses, curriculum documents and lesson observations have been described in Chapter 4. The findings have been discussed in Chapter 5. It was concluded that Biology teachers do implement environmental topics but to a limited extent. This is because of too many constraints and teachers normalised practices that hinder maximum implementation of environmental topics. This means as indicated in this chapter that there is a need for interventions from the Department of Education to ensure that teachers get the necessary support, resources, training among others, to be able to produce environmentally literate citizens and knowledge-based citizens by Vision 2030.

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## **Appendix 1a: Consent letter**

To: Mr./Mrs./Miss P1, P2, T1, T2, T3 and T4

X, Y and W Senior Secondary school

Windhoek

Namibia

### **Dear Sir / Madam**

I am a registered full time Masters in Environmental Education student at Rhodes University in South Africa. As part of my degree I am investigating how Grade 11 and 12 Biology teachers implement Environmental Learning (EL) in their classrooms. As part of the study, I intend on answering the following questions:

- How is EL implemented (facilitated) in the Biology classroom?
- What influences the implementation of EL in the Biology classroom?
- What are the enabling and constraints of implementing EL in the Biology curriculum?

To answer these questions, I need to interview Grade 11 and 12 Biology teachers and observe some of their lessons as well as analyse some of the relevant documents. I have thus chosen your school and you as a grade 11 and Biology to participate voluntarily in this study. All interviews will be recorded. Ethical issues such as confidentiality, right to privacy, dignity, and honesty will be maintained. Your name will not be revealed anywhere in the study.

**If you agree to participate in this study, please sign the consent form in the space below,**

**Signed** \_\_\_\_\_ **Date** \_\_\_\_\_

Your positive regard on this matter will be highly appreciated.

Yours faithfully

Sirkka Tshiningayamwe

## Appendix 1b: Consent letter

The principal

X, Y and W Senior Secondary school

Windhoek

Namibia

Dear sir /Madam

### **Re: Request for a research site**

I am a registered full time Masters in Environmental Education student at Rhodes University, South Africa. To qualify for this degree, I am required to carry out a research study. I have chosen to do an investigation on how Grade 11 and 12 Biology teachers implement environmental learning in their classrooms.

I am therefore requesting to do my study in your school. The school's participation in this study is voluntary; this means the school will participate willingly and can withdraw from the study at any time.

If I am allowed to carry out my research at your school, I will spend about a week at the school in June/July and will be involved with Grade 11 and 12 Biology teachers, have interviews with them and observe some of their lessons. The interviews and discussions shall be tape recorded. Ethical issues such as confidentiality, right to privacy, dignity, and honesty will be maintained. No names will be revealed.

**If the school is willing to participate please sign the consent letter in the space below.**

Principal signature \_\_\_\_\_ Date \_\_\_\_\_

Your positive regard on this matter will be highly appreciated

Yours sincerely

Sirkka Tshiningayamwe (081 239 5544 or [sirkkaa@webmail.co.za](mailto:sirkkaa@webmail.co.za))

## Appendix 2: Interview schedule

### Semi structure interviews

#### Teacher's profile

1. Years of teaching experience
2. Professional Qualifications
3. Years of teaching Biology at grade 11 and 12 level.
4. What do you understand by EL? (Give examples of EL in Biology).
5. Previous exposure to /implementation of EL.

- **EL implemented (facilitated) in the Biology classroom.**

1. What methods do you use in teaching EL in Biology and why?
2. In what ways do you engage learners in the EL lessons?
3. Do you encounter any problems while involving learners in activities? If yes, what are the problems? (language, discipline, timing etc)
4. Are there any alternative teaching methods you would you to use to teach EL but cannot use them? Which and why?

- **Influences of the implementation of EL in the Biology classroom.**

1. Do you have any teachers guide to the Biology syllabus you are using? If yes, how helpful is it? If no, what is your suggestion?
2. What policy documents apart from the syllabus do you have which assist you in implementing Environmental learning in Biology? (e.g subject policies, ministerial documents)
3. How do you use these policy documents in implementing EL in the Biology curriculum?

- **Enables and constrains of EL in the Biology curriculum.**

#### **3.1 Teachers knowledge and teaching materials**

1. In your opinion how would you describe your EL knowledge?
2. Where did you get your EL knowledge?

3. Do all the learners have Biology prescribed textbooks? If no, how do you cope with the problem of lack of textbooks?
4. How useful is the prescribed textbook in teaching EL topics in Biology?
5. Are the textbook (in terms of language, content, activities) at the level of learners? Why do you say so?
6. What other supporting materials are available for teaching grade 11 and 12 EL in Biology? Where do you get these support materials?
7. How do you make use of these extra support materials to teach EL topics in Biology?
4. What other support materials would you like to have to assist you teach EL in Biology? Why?
5. What is your opinion on the availability of resources for teaching EL? Why do you say so? (Are they adequate?)

### **3.2 General support**

1. Have you ever received in-service-training in EL implementation in Biology? If yes, how useful did you find the in-service training? If not, why not? (how often, what level, what kind?)
2. Has the advisory teacher ever visited you during any EL implementation lessons in Biology? If yes, How did the visit of the advisory teacher help you in implementing EL in Biology, if not why not?
3. What kind of projects do you have in your school which helps you with implementing EL in Biology? How does the project assist you in facilitate EL in Biology?
4. In what ways does the school management support you in implementing EL in Biology?
5. Do parents (community) support you and the learners in any way in implementing EL in Biology? If yes, how are they involved? If no, what is you opinion on that?
6. How supportive are the other teachers in helping you implement EL in your classes?
7. How does the support you receive help you implement EL in biology?
8. Are there any comments you would like to make in relation to support regarding EL implementation in Biology?

### **3.3 Time allocation**

1. Tell me, about how much time is allocated for teaching EL in Biology?
2. How did you decide on the time allocation on the classes?
3. Is the time sufficient for teaching EL? Why?

### **3.4 General Problems and constraints**

1. In your opinion, what constraints do you encounter in implementing EL in Biology?
2. What enables your implement EL in your classes?
3. Are there comments/ suggestions you would like to make regarding the constraints and enabling of EL implementation in Biology?

### Appendix 3: Observation Schedule

#### Observation guidelines

<p><i>Lesson objective</i></p> <p>Introduction of EL lesson, lesson objectives, expectation from lessons about EL in lesson.</p>	
<p><i>Instructions / teaching methods</i></p> <p>Instructional strategies / method of presentation, nature of activities, use of EL terminologies</p>	
<p><i>Learners engagement</i></p> <p>Learners engaged, in what, to what extent do learners participate, teachers' role in the lesson , learners encouraged to do and not do, learners given opportunities to interact with the materials and how, how are learners exposed to the teaching/ learning.</p>	
<p><i>Assessment/ evaluation</i></p> <p>Kinds of assessment, content and focus, time is allocated to activities, the teacher -learner relationship with regard to teaching/learning of EL</p>	
<p><i>Learning interactions</i></p> <p>Context of interactions occur, where interactions begin, type of learning /teaching resources/ aids used by teacher during EL lesson?</p>	
<p><i>Other key issues</i></p> <p>Class arrangement, size, displays, timetable</p>	

## Appendix 4: A sample of an analytic memo

### Analytical Memo 2: Teaching approaches used to teach EL

Category	Comments/opinions	Source
Current teaching methods	LC approaches, library work, experiments, using demonstrations, learners' prior knowledge  Class based/ teachers centred Group discussions Telling learners to find information prior to lesson Exposing learners  Asking questions teacher presentation Using Definitions Explaining and giving summaries	D2, D3, D1 LO1-LO18  T2, T4 P1, P2 P1 T1, T3,   LO1-LO18/D4
Assessment	Tests, projects, class work, self assessment, worksheets, assignments, written work, promote project work, informal / oral questioning, less coverage in the exam	D1, D2, D3, D7, P1-T4
Learners engagement	Answering questions, few asking questions and taking notes, others listening to the teachers , few uninvolved, discussions	LO1-LO18, P1-T4, D2,D3
Problems encountered engaging learners	Lack of interest, lack of knowledge, not doing the work, do not participate, lack of exposure	P1,P2,T1,T2,T4, LO1-LO18
Alternative teaching methods	Field trips Video/video clips/ exposure/visualization Practicals	D2, D3,D1, P2-T4 P1
Reflections	Done, critical reflections on lessons	D2, P2,T4,T1
	Not done/sometimes (workload) Good for improving pace of teaching, revising certain topics	T3
Using local examples	Diverse learners, use examples from their areas, cultures and communities	D2, D3, P2,D6, T1, T2, T3, T4

## Appendix 5: A sample of a colour coded interview transcript

### Responses to semi-structured interviews

#### Interview 2

##### Teacher (P2)

- Teaching experience – 7 years
  - Teaching Biology – 3 years
  - Qualification – B. Ed (Biology and Mathematics)
1. Approx EE biology content coverage – I think seriously speaking Environmental aspects are about 5%, however these issues are cross cutting, (EN) so you find a little bit of that here and there. Maybe a little more than 5%
  2. Would you say this is enough – I think at this moment of time for grade 12 level are sufficient and the rest, they can continue with it at tertiary level.
  3. Preferred teaching strategies/ approaches for EL - the ideal, which is def something that I have not done is take them out into the field and let them see what is happening, let them see the interactions between animals, however that is not perhaps practical for now (CR), *Currently is a matter of discussions in class, learners bringing in their backgrounds or the information that they pick up here and there, be it from videos they see or television and that perhaps becomes the central point of discussion to expand or to build on.* (TM)
  4. What do you mean taking them out is impractical? – it is practical as such but the cost implications that are there, an excursion (TM) can do the job, perhaps you plan it thoroughly during the holidays, one can take them for a week or so out for an excursion to one or another national park , and then that will expose them directly, but that have cost implications, currently we are challenged in terms of transport, we only have a small car, we don't have a school bus And it is an average of 40 learners that we have in the biology classes. So that is the challenges we need to overcome. (CR)
  5. Problems experienced/encountered in engaging learners in activities/discussions – *Time is never on the side of the teacher.* (CT) *when discussions are getting interesting, one does not really explore all the avenues as far as the ideas coming from the learners are concerned because of time constraints, because you are given this much work to cover in particular time frame, and that also limits the*

implementation of this topics. Another constraint is also that not all learners are active in the discussions, (CI) there are those learners that are just there not participating. Those are some of the limitations

6. What do u do when you want to discuss something and there is no enough time – put it off for another day, conclude with giving them a work assignment or homework (TM) of some kind to read up on the issue, most importantly we have afternoon sessions but particular the grade 12 that I teach have this year are not really coming in numbers but those that come in, we explore the issues further as far as the topic is concerned, usually every Wednesday afternoon, 2-4 is were we take it further to explore the problems they are having and discussions.
7. How do u involve learners / motivate that do not contribute to discussions - at times I put them on the spot by challenging them to have an input on what is going around, the atmosphere that we have in the class is that there is no right or wrong answer, they are always encouraged to speak their mind, whatever their comment is, that is at least the way of giving them the courage or the confidence to say whatever is on their mind thus at times when u see that this one is not performing you just put him/her on the spot to say something on the whatever issues is being discussed and the rest of the learners will add or build on the idea to shape the answer. Helps even not perfect.
8. Why is important for learners to include their experiences in the discussions on EL – *Using learners experiences in the discussions on EL, boils down to LCE , the learners have ideas, its not like they don't know what is going out there in nature, if one have to look at EL, they see the experiences and so on and indeed by sharing their experiences not only are they learning but the information they are getting at the end becomes their own, its only a matter of triggering them to realise that they know these things and then they can also learn from each other as they come from various parts of the country. They can also learn from each other as they come from various parts of the country. Example A learner coming from Katima (the north) will learn a thing or two from a learner coming from Karas ( down south) for example up north they have rivers, the hippos and crocodiles while in the Karas , they have other things that they do not necessarily have up north.* (TM)
9. Alternative teaching methods you would like to use and cant use apart from excursions and fieldtrips (CT)– in terms of alternatives at this point in time as far as EL is concerned, perhaps one could take them out of class and take them to a small ecosystem example a pond. I m looking into the possibility should I be teaching Biology next year or even this year already, of taking them to the Gammams wastewater treatment plant, look at water recycling and everything that goes into it,

*I am also looking at the possibility of taking them to the Goreangab dam where they will look at the ecosystems around the dam, we can have a discussion around that area, hopefully that will also promote interest within some learners even to go into environmental studies or conservation studies beyond grade 12. again the main constraint here is transport (CT), I m looking at the perhaps of booking a big bus from one of the schools or even the municipality to take them there and to talk to my fellow teachers, to allow me to take them for a day or at least several hours from school, because they are not only doing biology, they also have other subjects that they take in the course of the day so it will have implications on the whole school programme. (AR)*

### **Influences**

1. Main influence that influence the way you implement EL topics – I think in terms of implementation, the main influence will be the type of learners that I (IN) have, they have a role to play in how I teach, *secondly, My love for nature (EN) that I developed over time and of course during my studies when I took ecosystem ecology and subjects related to the environment. Indeed the reason why I am a Biology teacher today is because of the love that I had for environmental Biology that influences it a lot.* and perhaps the movies that I watch, the episodes that I see on Television, on this issues, animal geography and animal planet, or those somehow I also find tuning what I know as far as EL is concerned that I definitely share with my learners when I see anything that is related to that. And perhaps the policy documents that are around somehow also guide me in terms of what I share with them.(EE)
2. What policies do you use – at this moment in time, *I do not have any documents policies (CR),* but for example the conventions policies that they have signed in terms of protection of the species that are getting extinct, those are some of the things that I know for sure are there and perhaps take advantage of in preparing and sharing information with learners.
3. *Would you say you are confident in teaching the EL topics - when I teach this topic I do not have any doubt, I share with the learners what they need to know as far as the syllabus is concerned,* I think, I also go beyond what they are expected to know in terms of the syllabus, *I think I am fairly exposed in terms of knowledge in the area, even though time can never allow me to cover all there is to cover. (EE)*
4. What other ministerial policy guides do you use except the syllabus – (CR) *currently I don't have physical policy from the ministry apart from the syllabus, I am guided by my instincts thinking this is right and this is wrong".* But in general the *national curriculum for schools policy, subject policy*

all **subject guide** all those are somehow informing my practice on how I should implement **(IN)** this, the major areas they give there is “creating responsible citizens, having learners that are taking care or that are aware of their environment and takes care of their environment for their own current generation and generation to come. it boils down to learner centered education” I think those are the core guiding principles that I captured from the various documents that are there.”

5. Does the school have any internal policies that contributes to your EL implementation e. subject, assessment policy, homework – **yes, the school have an internal subject policy, specifically for biology internal subject policy and this is drawn in line with the national policy for the natural sciences, they guide the teachers across in terms of the amount of homework to be given, the number of assessment (ER)** to be given per term, for instance we know that the grade 11 and 12 do not necessarily have continuous assessment however it is expected of the teacher to at least have 4 assessment activities that are recorded as marks per term, these are guidelines that are contained within this policies.
6. What type of resources do learners use for these EL topics - in terms of resources , I always **encourage learners to use various books (ER)** because my believe is that the Biology book or the book that you are reading is as good as the author or the person who wrote the book, so the more books you read the better equipped you are because you are exposed to the **lions** of thinking of various writers, I always tell them if you read a biology book written by an environmentalist, perhaps the other aspects of biology will be there captured but not as concise as that of the units covering the environmental biology for instance cause that will be his/her area of specialization. **Currently the learners have the NAMCOL booklets or modules and they also have the second biology book for Southern Africa so those are the main books the school is providing them with, however I always encourage them to buy extra resources** if they have the finances to do so and I make them copies here and there. **But they all have two textbooks that the school provides.(ER)** (all the module and southern for Africa textbook)
7. What other support learning materials do you use to implement EL – things like **handouts that I give them whenever I find something useful to the topics or relevant to them. (ER)** At least they have **internet (EI) access at the resource center at school, which could help them to do research on topics that they have interest on;** those are the key things that we have at school currently.
8. Materials you would like to use that you cant use currently – **video clips that are topic (CR)** *If I were to look at Biology environmental topics one would perhaps like to show them what they show*

*on Sunday afternoons on NBC on the Kruger national park, how they move the animals or how they take care of the wounded animals and perhaps the interactions between animals, the lions how they live within the park, the hyenas and the feeding relations that are there. If one could have those topic based videos perhaps it could add value to what we are doing because one can perhaps give them the videos to watch and let them write an activity having observed what is happening, at least that brings the park into the classroom, if you cannot take the learners to the park than one needs to bring the park into the classroom.*

9. What is your opinion on resource availability at school – “in terms of resources it is never sufficient,” (CR) but honestly and being realistic we have an advantage over many other schools, mainly because we are in whk. We are exposed to a lot of things and one is grateful for that, however *I think we can still improve, for example we do not have a fully fledged lab at school, we do not have models, and those are things that we can work on to improve as an institution perhaps to better deliver services.* (CR)

### **General support**

1. Have you ever attended any workshop/in service training – workshop in general as far as biology is concerned, *I have attended one workshop, it was looking at practical activities in biology and how it can be done, it was informative indeed, and after the workshop, the schools received some resources that could be used for practicals in* (ES) biology for example chemicals needed to do food tests, perhaps not directly *environmental related, In terms of in-service training it comes at the cost again,* in service training you are taking teachers out there, learners are left without a teacher, all those need to be considered.
2. How supportive are the other teachers when it comes to EL – *teachers in general understands* (ES) that there is a need for a teacher to be absent or perhaps for learners to be away from schools for various reasons but if done often, some teachers are of the opinion that they miss out, they also have so much *time* (CT) to finish the own work of their various subjects for example the case in point that I am trying to referring to here, is if learners are to go for career exhibitions, *this year alone the grade 12 have been gone for at least 5 times because of various career exhibition* they had around town and because of that justifiably some teachers started asking questions in terms of their time now being used up out there because they feel they have *so much to cover versus the little time and if on average every month learners are out*, (at least once a month) of class for this or that or to the national theatre for a play that is there and is relevant for their English lesson or career exhibition

than teachers start asking questions. But yes as much as we understand our work is also compromised for other activities and subjects.

3. Support from principal and advisory services – in terms of advisory services, apart for the workshop that they here and there organize, I think they can do more, there is still room for improvement on their part, because, *I think the only communication that is most of the time there is when there is policy change, and it comes on paper telling you this is the way you calculate your CASS marks or this is how the format of question paper ought to be and physically they are hardly in the schools, myself for being in a school for 7 years, I do not recall a day that an advisory teacher (CS) visited me to observe my lesson regardless of the subject so that leaves a lot to be desired, I think they should play a more active role, were they should come to schools, not to police but to guide were teachers go wrong, That's the major problem I see. At school level, in the department, mathematics and science, there is an understanding that we share knowledge, we share the little that we have in terms of expertise and experience and that builds team work and that also helps learners in general. we even go to the extend of asking a colleague to teach a topic or to explain an aspect that we are not comfortable with to the extend of changing classes for a lesson or two should one be competent in an aspect that you are not competent in.*
4. Support from community / parents – *with fellow schools, schools around us are helping us, as I pointed out earlier we do not have a biology labs for practicals (ES) because we were a former hostel that have been converted into a school, space is not enough to build, H-LEVEL biology write practical exams. (ES) During the exams for example we get assistance from our neighbouring schools , they accommodate our H- level learners for practical exams, in terms of equipments that we do not have, we go to their extend of getting their equipments and use at our school and eventually return them, so that is the type of support that we get. In Namibia we have a cluster system, I think cluster schools can do more, currently the schools that I mentioned that are supporting us are not necessarily the schools in our cluster system, I think at cluster level we can do more for instance share resources and expertise at cluster level that will only add value to our work, but for whatever reason our cluster system is not efficient in that regard. (CS)*
5. Parents – *yes there are a few (ES) that are contributing however we have parents that are not keen on monitoring the academic work of their children. (CS) just the other day, we had a parent meeting and some were we had parents did not even see the report cards of their children, when we asked*

why, they just shake their shoulders, as a result that also have a negative impact on the performance of the learners in general.

6. Learners interest in EL – we have a combination of both in terms of academic performance, **there are learners that are in school and because they know why they are at school, they are purpose driven (EL)** as far as their school work is concerned, they know that this is what I want to become, and to become that I need a good grade in biology or a good grade in this or that subject and they work towards obtaining the good grade, and then you have other learners that do not dream at all, they are just at school because they are told to be at school or because everyone else is at school. **unfortunately we also have those learners in our system and one only hopes the change for the better as soon as possible, that can also be addressed as in as much as it can be addressed by all teachers.** **(CI)** I think the life skills and guidance teachers can do a good job in that regard, to guide the learners accordingly.
7. General comment on support – **general support again one could perhaps hammer on the issue of discipline in schools,** **(CD)** that can only be achieved if the key stakeholders are at play and are doing what they ought to do, the child should know that I am in school to learn, and he/she as a child should do just that, the government should be there to come up with policies that are conducive, policies that are not demoralizing or demotivate teachers in any way, they should not just **discipline** teachers they should have mechanisms in place to discipline learners as well teachers that are not bringing their part, and again many a times we dwell so much **on parents being illiterate,** hence them not taking responsibilities for the learning of their children, I think the parents can also do a lot more, **(SG)** others are very much reluctant in paying school development fund of their children, and its this **funds** that the school can use to acquire things like to build **laboratory facilities,** government is taking forever to do that, or perhaps acquiring vehicles for the school to **transport** learners easily compared to hiring transport and perhaps video clips would be purchased if the funds were enough and more **textbooks** all for the benefit of the learner academically. **(CT)**  
**(CR)**

### **Time constraints**

1. How do you decide on time for implementation and testing learners – when I come up with the **scheme of work (IN)** and the year planner and sits down and look at the number of days that you have and the workload than you start allocating in terms of percentage how many days I spend on the specific topic. Now the planning is always affected, for instance there is this and that holiday or

one is perhaps sick, and many other factors are at play. That is how one allocates time, by looking at the overall number of days per term as such and you start distributing accordingly, apart from that one is also guided by the pace at which the learners are going, because I am not only giving the tests at the end of the unit but also in the middle of the unit one also assesses them, in terms of assessment one is continuously assessing because one is advocating assessment for learning and not necessarily TM) assessment of learning because when you assess for learning, you use assessment as a tool to aid the learning process while the people that are only using assessment of learning they only assess what the learners have learned and what they did not learn and many at times they do nothing about the results they are getting, so assessment for learning gives you the chance to see this is what they did not learn and this is what I need to build on for them to also realise that this is a fact or something that they owe to know.

2. Apart from tests, how else do you assess learners – except for the written tests, I give them worksheets or assess them orally in class while teaching, while explaining while asking because that is already an assessment in itself, because the responses you are getting already guides you or gives you an idea of what they know, what they still need to know and what you need to work on with them for make them achieve the competencies that ought to be achieved by them at the given time. (TM)
3. How do you reflect your own teaching- in terms of reflection, overall I always go back and look at the topic versus what went on in class, TM) that guides me in terms on whether they have achieved or I have achieved what I have done. For example with reference to the topic on EL, just the other day we were talking about predator and prey relationships and the curve that can be plotted, I realized that after the lesson the learners still did not understand, we went and I gave the learners that understood the chance to explain to the others to the extent that some were even speaking their local language (mother tongues) and that perhaps also helped them to understand the work, all those are things that one does to make sure they understand what they are supposed to know.
4. Are EL terminologies difficult for learners – in terms of terminologies, they are not that challenging, (EL) just that everything that is new or strange to anyone will seem to be challenging, but as time goes they build confidence they start using them, I think one of the ways to encourage them to get used to these terminologies and not be strange for them, is when one uses them on a regular basis with them and not just using everyday language these help them to better understand and to really master this terminologies, however at times they are challenged in terms of spelling of

some of terminologies , one only encourage them to get used to writing them out and practice them when studying or revising their work then it becomes easier.

5. General constraints – boils down to time and the vastness of the topics itself and the fact that one cannot take them out to the field to see what is going on example the parks are far and it comes at the cost to go there. (CT/CC)
6. What makes it easy – they are easy because they are cross cutting, EL topics are taught across the curriculum , EL are well captured under different subjects that we have i.e geography, economics and that only makes it easy for the teacher because some aspects are already taught in geography to make them answer questions in biology.
7. Suggestions /comments regarding constraints and enabling of EL implementation – in terms of suggestions perhaps, I think providing schools with videos of what is happening in national parks will make life easier to implement the EL , NIED (ministry of education) when they are coming up with the curriculum , especially the practical aspects of EL , it is perhaps not that easy to take out learners into the field but as said earlier the parks can be brought to the classroom through videos and all and in so doing it will be much relevant because it will capture all the aspects for example the stories or issues of food chains and food webs and how natural balance can be changed should there be human interference or interference that is not positive.
8. How are EL topics covered in the exams – depends from year to year, what I have seen over the years, they try to include it here and there but in terms of coverage they can create more space for that type of biology for more questions in that regard, how ever, they are 5% of syllabus coverage which means 5% of exam marks, at times they tend to bring it on in the multiple choice paper , and sometimes paper 2 and not necessarily paper 3, very rare that you find it in paper 3. (TM)

## Appendix 6: Sample of learner given test/activities

██████████ HIGH SCHOOL

NAME: \_\_\_\_\_

BIOLOGY

JULY 2011

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### CHEETAH (*Acinonyx jubatus*)

The cheetah has been described internationally by the IUCN as a threatened species which is in immediate danger of becoming extinct. Its continued survival is unlikely without the implementation of special protective measures.



1. With reference to *Acinonyx jubatus* explain the term binomial. [3]
2. Below are several sets of two or three words. Write the word from each set which best describes the cheetah. [7]

**Feeding level:** Omnivore – Carnivore – Predator

**Habitat:** Desert – Savanna – Mountains

**Member of:** Cat family – Dog Family

**Speed over short distances:** 50 km/h – 70km/h – 100 km/h

**Prey animals:** Insects – Small Antelope – Large Antelope

**Number of cubs:** One – Two to four – Four to six

**Hunting time:** Mornings and evenings – Only at night – Day time

3. Make/draw a simple food chain involving four organisms of which a cheetah is one of the organisms. [1]
4. Define the term antelope. [2]
5. Namibia has the largest cheetah population in the world to be found living naturally on farmland (not in parks or in conservation areas). Cheetahs are found mostly in the central savanna areas. Many cheetahs are shot each year by farmers because they feel the cheetah present a treat to their livestock. We have a large population of an endangered species and thus the moral obligation to protect it but at the same time, livestock farmers need to make a living.

As Namibians how do we solve the dilemma of this situation? [7]

Appendix 7: Lesson plans

Lesson 3 (LO3)

LESSON PREPARATION

TEACHER:.....	GRADE: 12A	DATE: 20-05-2011
SUBJECT: <i>Biology</i>		
THEME AND TOPIC: <i>Human Influence of the Ecosystems</i>		
TEACHING AIDS AND RESOURCES TO BE USED: <i>OPP</i>		
LEARNING OBJECTIVES WITH THE LESSON: Learners will: <i>Consider the effects of human activities on the ecosystem.</i>		
BASIC COMPETENCIES (Refer to Syllabus): Learners should be able to: <i>- Describe the undesirable effects of deforestation</i> <i>- Describe the overuse and dangers of fertilisers on the land.</i>		
PRESENTATION OF THE LESSON:		
1. Monitoring of homework done: <i>N/A</i>		
2. An appropriate short introduction: <i>Brainstorm work done in previous lesson not give lesson objectives.</i>		
3. Presentation of subject content and learning tasks: <i>- Discuss the effects of deforestation on the ecosystem and ways of reducing the effects.</i> <i>- Then discuss the use of fertilisers on the land and their effects.</i>		
4. Consolidation.....		
5. ASSESSMENT / HOMEWORK / TASK / EXERCISES		
OPPORTUNITIES TO DEVELOP LEARNERS' ENGLISH READING AND WRITING SKILLS IN THE SUBJECT:		
Reading activities	<i>To be developed as learners read textbooks</i>	
Writing activities	<i>To be developed as learners make summaries.</i>	

Signature H.O.D/Principal: .....

Date: .....

Lesson 4 (LO4)

**LESSON PREPARATION**

<b>TEACHER:</b> .....	<b>GRADE:</b> 12 A	<b>DATE:</b> 23-05-2011
<b>SUBJECT:</b> Biology		
<b>THEME AND TOPIC:</b> Human Influence on the Ecosystem		
<b>TEACHING AIDS AND RESOURCES TO BE USED:</b> OHP		
<b>LEARNING OBJECTIVES WITH THE LESSON:</b> Learners will: Consider the effects of human activities on ecosystems.		
<b>BASIC COMPETENCIES (Refer to Syllabus):</b> Learners should be able to: - Discuss the use of modern technology to increase food production and its negative effects.		
<b>PRESENTATION OF THE LESSON:</b>		
1. Monitoring of homework done: Brainstorm work done in the previous unit.		
2. An appropriate short introduction: Introduce the new unit and start by asking learners how humans influence the		
3. Presentation of subject content and learning tasks: ecological balance of nature - Use the notes on the OHP transparencies to discuss the use of modern technology to increase food production.		
4. Consolidation: Recap the main ideas.		
<b>5. ASSESSMENT / HOMEWORK / TASK / EXERCISES</b>		
Study work done.		
<b>OPPORTUNITIES TO DEVELOP LEARNERS' ENGLISH READING AND WRITING SKILLS IN THE SUBJECT:</b>		
<b>Reading activities:</b> Read pg. 153 - 159		
<b>Writing activities:</b> Make notes as they study their work.		

**Signature H.O.D/Principal:** ..... **Date:** .....

Lessons 8 to 11 (LO8-LO11)

LESSON PREPARATION AND PLANNING SHEET

SUBJECT: Biology

GRADE: <u>11th</u>	MONDAY DATE: <u>27/06/2011</u>	TUESDAY DATE: <u>28/06/2011</u>	WEDNESDAY DATE: <u>29/06/2011</u>	THURSDAY DATE: <u>30/06/2011</u>	FRIDAY DATE: <u>01/07/2011</u>
LESSON TOPIC	Antibiotic-resistant bacteria	Artificial Selection	Energy Flow	Food Chain and web	produler and consumers
SYLLABUS REFERENCE	A-5	A-5			
TEACHING AID(S)	- Chalkboard - Textbook	- Chalkboard - Textbook	- Chalkboard - Textbook	- Chalkboard - Textbook	- Chalkboard - Textbook
LESSON OBJECTIVE	Discuss the development of antibiotic resistance in bacteria as an example of natural selection.	Describe the role of artificial selection in production of varieties of plants and animals.	Explain that the sun is the principle source of energy input to biological systems.	Explain that sunlight energy is transferred to chemical energy during photosynthesis and respiration.	Explain the meaning of consumer, producer, herbivore, carnivore, decomposer, trophic level etc.
LESSON CONTENTS	- Development of antibiotic resistance - natural selection - ways in which to control use of antibiotic	- Roles of artificial selection - production of varieties of animals and plants - increased economic importance	- Source of energy - Use for sunlight energy - non-cycle flow of energy	- light energy - photosynthesis - Respiration	- Food Chain - consumer - producer - carnivore - decomposer - Trophic level

Lesson 13 (LO13)

### LESSON PLAN

"Teacher, if you do not know where you are going with the learners, any road will get you there; but you will not know that you have arrived" A LESSON PLAN is your decision where to go, how to get there and how to know when you have arrived.

TEACHER: [REDACTED]	GRADE: 12	DATE: 5/07/2011	DAY: .....
SUBJECT: BIOLOGY			
THEME AND TOPIC: Conservation			
TEACHING AIDS AND RESOURCES TO BE USED:			
LEARNING OBJECTIVES WITH THE LESSON: Learners will:			
BASIC COMPETENCIES: Learners should be able to:			
define conservation as maintaining the environment and natural resources in a state that maintains biodiversity. Describe the need for conservation of species and their habitats and of natural resources. Discuss the advantages and disadvantages of tourism for conservation. principle of recycling materials: e.g water (sewage), paper (trees), plastics and glass. Describe one conservation project			
PRESENTATION OF THE LESSON:			
1. Monitoring of homework done:			
Homework on self assessment question to be checked by asking learners to mention their answers.			
2. An appropriate short introduction:			
we do not know how many species there are in a particular habitat. Human activity is destroying large areas of rain forest and with it many species of organisms some of these species become extinct as a result of human activities			

SIGNATURE: TEACHER \_\_\_\_\_

HOD: \_\_\_\_\_

3. Presentation of subject content and learning tasks:

What is conservation?

Importance of plants.

→ maintain the levels of carbon dioxide and oxygen in the atmosphere

→ source of timber which can be used in building and making furniture

→ produce oils - intake in the human diet and medicinally

→ produce drugs

Conservation of habitats

Importance of conservation

Example of conservation projects

ASSESSMENT / HOMEWORK/TASK/ EXERCISES

Self - Assessment questions

OPPORTUNITIES TO DEVELOP LEARNERS' ENGLISH READING AND WRITING SKILLS IN THE SUBJECT:

Reading:

Writing:

SIGNATURE: TEACHER

HOD:

## **ENERGY FLOW, FOOD CHAINS AND FOOD WEBS**

### **OBJECTIVES:**

- ⊗ **State that the sun is the primary source of energy for all living organisms**
- ⊗ **Describe the one-way flow of the energy from one organism to another**
- ⊗ **Describe what the following terms mean: food chain, food web, producer, consumer, herbivore, carnivore, decomposer, ecosystem, ecology**
- ⊗ **Describe how energy is lost as it passes from one organism to another**
- ⊗ **Describe the advantage of a short food chain**
- ⊗ **Describe and interpret pyramids of biomass and energy**
- ⊗ **Discuss the increased efficiency resulting from humans eating green plants instead of eating animals.**
  
- ⊗ **State that the sun is the primary source of energy for all living organisms**
  - ☞ **The sun is the principal source of energy in a biological system**

- ☞ The light energy from the sun is into chemical energy which passes from one type trophic level to another.
- ⊗ **Describe the one-way flow of the energy from one organism to another**
  - ☞ Energy enters an ecosystem as sunlight. The energy is used by plants in photosynthesis, to make carbohydrates and other substances
  - ☞ When animals eat plants, they obtain some of this energy. The energy flows between living organisms in the form of food.
  - ☞ Energy only flows one way as it does not return to the Sun and it is known as the **non-cyclical flow of energy**.
- ⊗ **Describe what the following terms mean: food chain, food web, producer, consumer, herbivore, carnivore, decomposer, ecosystem, ecology**
  - ☞ **Ecology**: the study of the interaction between living organisms and their environment.
  - ☞ **Ecosystem**: is the physical environment and all the organisms that live in it in any particular area.
  - ☞ **Producers**: are photosynthetic organisms (plants) that produce food at the beginning of food chains.

- ☞ **Consumers**: are animals that obtain their energy from other living organisms. Can either be herbivores or carnivores.
- ☞ **Carnivores**: Feed on other animals
- ☞ **Herbivores**: Feed on plants
- ☞ **Decomposers**: are bacteria and fungi (microscopic organisms) that obtain their energy when they break down the bodies of dead organisms.
- ☞ **Food chain**: is a series of organisms, connected by the a flow of energy. Each organism is at a different trophic level.
- ☞ **Food web**: is a number of interconnected food chains. It shows how energy is transferred from one organism to another within the same ecosystem.
- ⊗ **Describe the advantage of a short food chain**
  - ☞ Energy is lost as it passes along a food chain. There are therefore fewer organisms further up the chain.

## Appendix 9: Example of textbook practical investigations instructions

This practical activity may take you about an hour

### **INVESTIGATING AN ECOSYSTEM**

In this investigation you can look closely at an ecosystem near you and try out what lives in it.

You will need:

- measuring tape or ruler
- notebook
- pen or pencil

Look for a suitable area to be 'your' ecosystem. you could choose a garden, an area of waste ground, a pond, or a tree and the area around it.

You are going to describe, in your notebook, everything that you see in your ecosystem.

- 1** Write down the approximate size of the ecosystem.
- 2** List the non-living parts of your ecosystem, for example, soil, water, air, stones
- 3** Estimate how much sunlight it gets, for example, all day, morning only.
- 4** List all the different plants and animals you can see.
- 5** Try to identify as many of the animals and plants as you can.
- 6** Some animals will be easier to see than others. Write down how and where you found the hidden animals. Why do you think they hide?
- 7** Choose one plant and one animal, and look closely at the particular place where they live
  - a** What is the plant growing on?
  - b** Does anything eat, or live on this plant?
  - c** Where does the animal live?
  - d** What does the animal feed on?

(Source: Kadhila, 2008: 124)

**Appendix 10: Extract from higher level examination practical skills paper**

You have been provided with a fresh green leaf. The leaf has been partly covered and left in bright light for 48 hours.

**(a)** Using the apparatus provided, test the leaf for the presence of starch.  
Make a large outline drawing of the tested leaf, labelling the stained and non stained areas. [5]

Measure the longest length of your drawing from the end of the stalk to the tip of the leaf.  
*length of drawing* ..... [1]

**(ii)** Measure the longest length of your leaf in the same way and calculate the scale of your drawing. Show your working.  
*length of leaf* .....  
.....  
*scale of drawing* ..... [2]

**(c)** Describe how you used your apparatus to carry out the starch test and explain why you carried out each step of the process.  
.....  
.....  
.....  
.....  
..... [5]

**(d)** What does the result of your experiment indicate about the making of starch by plants? ..... [1]

**(e)** Suggest and explain how this experiment could be modified to show that chlorophyll is required for photosynthesis.  
*suggestion* .....  
.....  
*explanation* ..... [3]

**[Total: 17]**

## Appendix 11: Sample of teachers' timetable

### Time Table for T2

DAY	P1	P2	P3	P4	P5	P6	P7
1	NonT	09D	15	09A	12B	12A	09C
2	09A	12B	12A	NonT	NonT	10F	09B
3	12A	09D	15	09C	12B	10F	09B
4	09A	10F	15	12B	09D	09B	12A
5	09A	12B	12A	NonT	09C	NonT	09B
6	09D	12B	12A	09C	15	10F	09B
7	NonT	09C	15	09D	12A	12B	09A

### Time Table for P2

H.O.D MATHS AND SCIENCE DEPARTMENT	DAY ONE	DAY TWO	DAY THREE	DAY FOUR	DAY FIVE	DAY SIX	DAY SEVEN
TEACHERS MEET 07H05-07H20			MORNING	BRIEFING			
PERIOD REGISTRATION 07H20-08H05							
PERIOD 1 08H05-08H45		12A		12A		12A	10A
PERIOD 2 08H45-09H25	10D	11A/11B	10D	10C	10B	11A/11B	10C
PERIOD 3 09H25-10h05	10C	10D		10B	10C	11A/11B	
<b>10h05-10h30</b>	<b>B</b>	<b>R</b>	<b>E</b>	<b>A</b>	<b>K</b>		
PERIOD 4 10h30-11h10	10B	10C		10A	11A/11B	10A	11A/11B
PERIOD 5 11h10-11h50	11A/11B	10B	10C	10D	12A	10D	12A
PERIOD 6 11h50-12h30	12A	10A	10A	11A/11B	10A	10B	10D
PERIOD 7 12h30-13h10	12A		10B				
PERIOD 8							
	<b>L</b>	<b>U</b>	<b>N</b>	<b>C</b>	<b>H</b>		
PERIOD 9 EXTRA CLASSES							

## Appendix 12: Questions done in class

██████████ Secondary School

### Grade 12 Biology

#### 26 The human impact on the environment

1 List three human activities which could cause the loss of a species.

2 Distinguish between the terms 'pesticide' and 'herbicide'.

3 (a) What is the special property of a 'persistent' insecticide?

(b) In what ways is 'persistence' (i) useful property, (ii) a harmful property?

4 Put the following events in the most probable order.

- (a) Predatory birds poisoned insecticides
- (b) Trees sprayed with insecticides
- (c) Earthworms eat leaves which fall from the trees
- (d) Predatory birds eat small birds
- (e) Beetles damage trees by spreading a virus.
- (f) Insecticides absorbed by tree leaves
- (g) Small birds eat earthworm

5 Put the following events in the probable order.

- |  |                                |
|--|--------------------------------|
| (a) Dead algae decomposed by bacteria                      | (d) Bacteria use up oxygen     |
| (b) Excess nitrate and phosphate discharges into the river | (e) Aquatic algae die          |
| (c) Fish die of suffocation                                | (f) Water depleted of oxygen   |
|  | (g) Aquatic algae grow rapidly |

6 What are the principal sources of excessive nitrate and phosphate in rivers and lakes?

7 List short term and long term effects of forest destruction (a) on hillside (b) in the tropics

8 In what ways does overgrazing lead to soil erosion?

9 Which of the following are likely to help conserve soil and prevent erosion?

- |                                    |  |
|------------------------------------|--|
| (a) Ploughing slopes               | (e) Removing trees from hillsides                    |
| (b) Planting trees on steep slopes | (f) Growing the same crops every year                |
| (c) Using chemical fertilizers     | (g) Keeping as many animals as possible on grassland |
| (d) Terracing hillsides            | (h) Using organic manure                             |

10 (a) What are the two main pollutants that contribute to acid rain?

(b) Where do these pollutants come from?

(c) What direct or indirect effect is acid rain thought to have on (i) lakes (ii) forests and (iii) buildings?

11 Which of the following are important 'greenhouse' gases?

*Oxygen, water vapour, carbon dioxide, nitrogen oxides, methane, nitrogen*

12 Which part of the carbon cycle is responsible for the increasing concentration of carbon dioxide in the atmosphere?

13 Explain briefly why the greenhouse gases lead to global warming.

14 By how much do we need to cut carbon dioxide emissions in order to halt global warming?

5%, 20%, 60% or 90%

15 In what ways do CFC's cause global problems?

16 (a) What do you understand by the term 'monoculture'?

(b) What is one disadvantage of monoculture?

17 Which of the following are not covered by the 1956 and 1968 Clean Air Acts?

- (a) Sulphur dioxide emissions from power stations.
- (b) Smoke emissions from factories
- (c) Particulate emission from vehicles
- (d) Emission of CFC's from aerosols spray

18 State two ways in which sulphur dioxide emission from coal-fired generating stations could be reduced

19 Which of the gases listed below can be reduced in vehicle exhausts by a (a) a catalytic converter (b) a lean burn engine?

*Carbon dioxide, carbon monoxide, unburned petrol, nitrogen oxide, water vapour, oxygen*